Straw pulp and paper mill, Moora

Moora Pulp and Paper Company Pty Ltd

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
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Summary and recommendations

The proposal by the Moora Pulp and Paper Company Pty Ltd incorporates various desirable elements. It is based on the use of a renewable resource (wheat straw) and the recycling of paper and cardboard (from Perth), and offers the development of a new decentralised industry. It is, however, a proposal which will require responsible management in order to avoid adverse environmental impacts.

The mill, which is to be located north of Moora, would convert approximately 95,000 tonnes of cereal straw into paper for containers, and would also recycle 50,000 tonnes of waste paper into a range of paper products. The effluent from the process would be either incinerated or treated prior to irrigation onto a 110ha tree plantation.

Following referral of the proposal, the Authority required the preparation of a Public Environmental Review document. As a consequence of a successful and extensive public consultation process undertaken by the company, public and other comment on the proposal was generally supportive, but issues of interest or concern were raised.

While a number of environmental issues have been considered by the Authority, the two main areas of interest are the impact on soil conservation of the harvesting of the straw and the implications of effluent disposal. With regard to the straw, the Authority is confident that, with appropriate advice, management and monitoring, adverse consequences can be minimised. Effluent disposal by irrigation into a tree plantation requires thorough knowledge of the site, the effective performance of the plantation, and monitoring and management to ensure that adverse effects that could arise would be minimised.

The mill will require pollution control licences for emissions of dust, noise, other air emissions and solid and liquid wastes. The outstanding technical issues with regard to these aspects, which mainly require detailed design, will be resolved through that approval process.

The Authority is satisfied that this proposal can proceed without causing unacceptable environmental impacts and has recommended accordingly.

Recommendation 1

The Environmental Protection Authority has concluded that the proposal to construct and operate a straw pulp and paper mill near Moora, as modified during the process of interaction between the proponent, the Environmental Protection Authority, the public and government agencies that were consulted, is environmentally acceptable.

In reaching this conclusion, the Authority identified the main environmental factors requiring detailed consideration as:

- **soil conservation aspects of straw harvesting;**
- **transport;**
- **solid and atmospheric emissions; and**
- **effluent disposal and plantation management.**

The Environmental Protection Authority notes that these environmental factors have been addressed adequately by environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations given in this report.

Accordingly, the Environmental Protection Authority recommends that the proposal could proceed subject to the Environmental Protection Authority's recommendations in this report, and subject to the proponent's commitments to environmental management as detailed in Appendix 1 of this report.

Recommendation 2

The Environmental Protection Authority recommends that the proponent, in conjunction with the Commissioner for Soil Conservation, should prepare straw harvesting guidelines and implement procedures to ensure that soil conservation concerns are minimised. Issues that should be addressed in those guidelines include:

- prevention of straw harvesting on unsuitable soil types;
- detriment to the soil by avoidance of continual removal of stubble from the same area;
- minimum length or volume of stubble to be retained;
- prevention of spread of crop diseases;
- time of harvesting;
- straw condition;
- method of harvesting, including the avoidance of raking; and
- reduced availability of straw below normal mill requirements.

In each of the first three years of operation the proponent should obtain a report from the Commissioner for Soil Conservation regarding the implementation of the straw harvesting guidelines, to the satisfaction of the Environmental Protection Authority. In the long term the Commissioner for Soil Conservation should monitor and report on the effectiveness of these guidelines through the annual report required under the Soil and Land Conservation Act.

Recommendation 3

The Environmental Protection Authority recognises the inherent advantages of rail transport and recommends that the Government investigate the feasibility of a rail spur into the plant site.

Recommendation 4

The Environmental Protection Authority recommends that the proponent should prepare and implement effluent disposal design, management and contingency strategies to ensure that potential on-site and off-site impacts arising from the operation of the mill, including:

- waterlogging and/or soil salinity;
- loss of productivity of affected neighbouring properties;
- contamination of domestic and stock water supplies;
- failure in part or whole of the tree plantation as an integral part of effluent disposal;
- dieback disease spread; and
- contamination of the Coonderoo River;

do not arise or are mitigated, to the satisfaction of the Environmental Protection Authority on the advice of the Water Authority of Western Australia and the Department of Agriculture.

Recommendation 5

The Environmental Protection Authority recommends that the proponent prepare and subsequently implement a social monitoring programme prior to the commencement of construction, in consultation with the Social Impact Unit.

1. Introduction

The Environmental Protection Authority has assessed the proposal by Moora Pulp and Paper Company Pty Ltd to establish a cereal straw and waste paper pulp and paper mill near Moora, in the Central Midlands district of Western Australia.

The Moora Pulp and Paper Company Pty Ltd is a subsidiary of the River House Group.

The mill is to process cereal straw to produce dried pulp. A portion of this pulp would be mixed with repulped waste paper to produce paper products. The pulp and paper produced by the mill would be mainly exported, particularly to South and East Asia, where the pulp would be used to produce fluting for container board and the paper would be used directly for packing.

The proposal was referred to the Environmental Protection Authority in December 1990. The level of assessment was set at Public Environmental Review (PER) and the PER was released for public comment for eight weeks, ending on the 12 April 1991.

Prior to referral the company undertook an extensive public consultation and information programme to ensure that the community, especially those people near and in Moora, and a range of other interest groups and government agencies, were aware of the proposal and had the opportunity to obtain further information on the project.

2. The proposal

The proposal entails the processing of both cereal straw, mainly wheat, harvested from the Moora and surrounding districts, and waste paper from Perth, into paper pulp and paper sheet.

2.1 Mill site

Before selecting the preferred site, the company considered sites in the Shires of Dongara, Three Springs and Gingin. The siting of the facility at Moora was finally chosen because of the availability of fresh water, access to good quality road and rail facilities connected to likely ports, and the positive support of the local community to the proposal. Two possible sites, both to the north of the town of Moora, were examined and the current site was selected as it was considered by the company to be more suitable for the disposal of saline effluent.

2.2 Receiving environment

The proposed mill is located on Location 2007, a site of approximately 210ha approximately 13km north of Moora, in an area zoned rural. The mill itself would occupy about 24ha of the site with most of the remainder of the site, approximately 110ha, being used for effluent disposal onto a tree plantation. Access to the mill would be from the Midlands Road by a new road to be built within an existing gazetted road reserve (Figure 1).

The site has been cleared of natural vegetation for agriculture purposes, but has not been actively farmed for about 10 years. Revegetation by naturally reseeded crop and weed species along with some native plants has occurred over much of the site.

The mill site lies adjacent to, and east of, the Darling Fault on sedimentary rock of the Moora Group that are overlain by aeolian quartz sands. The sandy soils of the site are considered suitable by the company for the disposal of the washwater by spray irrigation.

Water supply with a draw of up to 3,400 cubic metres per day from the Leederville Formation would be obtained from a bore to be installed west of the site. Approximately 2809 cubic

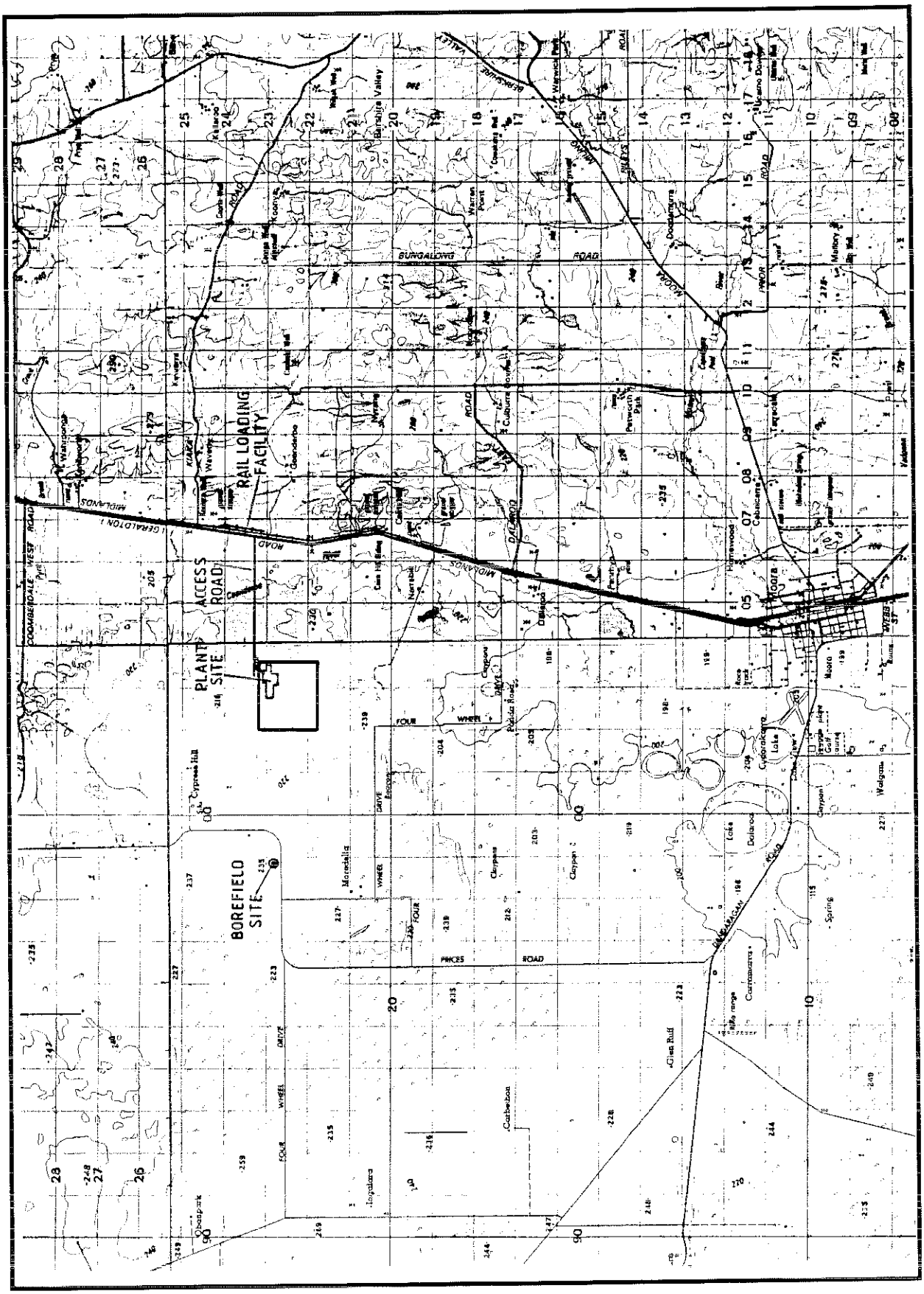

Figure 1: Location of Moora Straw Pulp and Paper Mill

metres per day of saline and highly coloured effluent would be treated and irrigated to the tree plantation.

The Coonderoo River lies approximately 1.5km east of the site and would need to be crossed by the mill access road. The river, a major tributary of the Moore River, forms part of a saline drainage system that extends north and east to Three Springs and beyond Paynes Find.

Location 2007 has three neighbouring land owners. Adjacent land has been largely cleared and developed for grazing of stock and cereal crops, but areas of native banksia woodland remains along each of the boundaries of the site. One area, on the eastern side, has been developed for wildflower production.

Moora is the regional centre between Perth and Geraldton and has a population of around 2,000. The town acts as a service centre for the surrounding rural areas and has a full range of Government services. None of the existing services or facilities provided in Moora are considered to be under stress.

The proposal should provide a significant benefit to the Moora and surrounding area due to the diversification of the economic base, the creation of long term employment and service industry opportunities.

2.3 Description of process

The straw pulp and paper mill proposal, as outlined by the Moora Pulp and Paper Company Pty Ltd in the PER would be designed to process 95,000 tonnes of cereal straw per annum into 67,000 tonnes of air dried pulp, and 50,000 tonnes of waste paper would be pulped and mixed with a proportion of cereal straw pulp to produce 50,000 tonnes per annum of paper products suitable for manufacture of container board.

Cereal straw processing would be achieved by breaking the straw up mechanically with a hammer mill and then digesting lignins or fibre bonding agents using caustic soda under heat. The liberated fibres would then be refined and washed to produce a clean pulp that would be subsequently formed into a mat for pressing and drying prior to being cut, rolled and wrapped for export. Alternatively, some of the straw pulp would be mixed with repulped waste paper to forming into a paper product.

2.4 Handling and storage

It is estimated that 95,000 tonnes per annum of straw would be required from an area within 150km of the mill site. Straw would be harvested and baled by farmers or contractors using well established methods. Straw would be delivered by road transport to the mill throughout the year from stockpiles held at various locations in the region while the mill stock pile would be sufficient for at least one month's production.

Harvesting of straw is anticipated to be concentrated on the more productive soils within 100km of Moora.

Other chemicals and materials stored on the mill site would include 13,200 tonnes per annum of caustic soda delivered by road tankers from Perth, 9540 kilolitres per annum of crude oil delivered by road tanker from Mt Horner oil field near Dongara and minor chemical storages related to the water treatment process.

Waste paper consisting of old corrugated container wastes and mixed waste paper would be collected in Perth and stockpiled at the mill site. It is estimated that 50,000 tonnes per annum would be required to be carried by road transport to the mill.

2.5 Waste treatment and disposal procedures

The mill would generate a number of solid, liquid and gaseous waste products.

Solid wastes consisting of inert impurities would be generated from within the straw and waste paper streams, straw material resistant to digestion and ash from the incinerator. It is proposed to dispose of this material in an approved landfill site. This would include 16.4 tonnes per day of incinerator ash which would be principally sodium carbonate and may be a marketable by-product. Sludges generated within the effluent treatment process would be burnt in the incinerator.

The mill would generate air emissions, principally from the incinerator stack resulting from the burning of crude oil fuels and also the black liquor. The atmospheric emissions generated would be sulphur dioxide and particulates, mainly sodium carbonate.

Anaerobic treatment of the washwater would produce biogas (methane) and this would be collected and burnt within the mill to generate steam and/ or power.

The pulping and paper making processes would produce two separate streams of liquid effluent:

- black liquor from the straw digestion process, with high concentrations of colour and a salt level of 28,000 milligram per litre total dissolved salts (mg/L TDS); and
- washwater from the refining, washing, repulping and paper making areas of the mill, having lower concentrations of colour and 4,800mg/L TDS.

Stormwater as well as domestic sewage would also generated at the mill.

The black liquor from the mill would be directed to an incinerator where it would be burnt to recover heat for process purposes, especially steam production, and to produce solid ash consisting principally of sodium carbonate. The incinerator would need supplementary fuel, either from crude oil or natural gas, and would be designed to control gaseous emission.

The washwater would receive anaerobic and aerobic treatment to reduce biological oxygen demand (BOD). The effluent (estimated to be 2,809 cubic metres per day) discharged from the treatment process would have a residual BOD of approximately 150mg/l and would be directed to a 110ha tree plantation for irrigation. It is proposed to use natural soil filtration and biological degradation to remove this BOD. The effluent, with a salinity of 4,800mg/l, would lead to the deposition of a total salt load of approximately 5,000 tonnes per year on the soil and in the groundwater beneath the site. In view of the nature of the effluent, the company has indicated in the PER that salt tolerant trees would be established and that they would absorb up to 50 percent of the volume of the effluent, with the remainder percolating through to the underlying groundwater.

2.6 Infrastructure and services

The plant would operate 24 hours a day and have a total plant workforce of approximately 65 people. The company has committed to use its best efforts to recruit the workforce from the local area.

It is estimated that up to 180 additional jobs would be created through straw collection and other transport related work. This work is seasonal and would not result in an equivalent number of "new" jobs being created. Some new jobs would be created and opportunities would be opened up for those workers in the area that are currently underemployed.

The construction period would be employ a workforce of 40 to 100 during a 21 month construction period. Construction workers would be housed in either a construction camp or by use of short term accommodation in Moora.

It is not intended that the mill would require connection to the SECWA interconnected power grid, although the possibility of connection to the natural gas pipeline to the west is mentioned in the PER. All water supplies to the site would come from private bores abstracting water from the Leederville Formation and would be located several kilometres to the west of the mill site.

The mill would be designed for a life in excess of 20 years.

3. Public review

Prior to the referral of the proposal to the EPA and subsequent release of the PER, River House Pty Ltd conducted a lengthy and detailed public consultation process. This process included contact with local community groups and public meetings in Moora as well as with conservation groups and government agencies.

The nearest neighbours to Location 2007 were directly consulted upon release of the PER for public review.

During the public review of the PER, a total of 21 submissions were received from members of the public, community groups, local government and government agencies. A detailed summary of the points raised in those submissions is presented in Appendix 2. The following topics were covered in the comments and submissions:

- sourcing and sustainability of cereal straw and paper requirements;
- water supply;
- significant increase in transport, especially road through regional towns and especially near the mill site;
- effect on the Town of Moora of additional employees and also during construction;
- use of local services and labour;
- atmospheric emissions from the plant, particularly noise, light, odour, sulphur dioxide (SO_2) and particulates (sodium carbonate);
- fire risk;
- solid waste (mainly sodium carbonate) disposal;
- site suitability for the disposal of liquid;
- impact on adjacent shallow groundwater resulting from liquid effluent disposal; and
- establishment and maintenance of the irrigated plantation.

The company's response to all issues and comments received by the Authority is included in Appendix 2.

Considerable support for the project was shown in the submissions. It is clear from the nature and content of the submissions received on the PER that the company's public consultation process was effective in ensuring that the local community is aware of the proposal and its potential benefits. In addition, it allowed people to be informed to a level which enabled them to ask important and relevant questions or raise and offer constructive comment. It is however considered that the nearest neighbours to the proposed site should have been given an earlier direct opportunity to take part in the process.

The Authority recognises the benefits of effective public consultation and information programmes and commends the company on its effort.

Effective programmes, such as that undertaken by the company, cannot ultimately satisfy all members of the community. Some issues and questions will always remain outstanding and not everyone will be satisfied with the nature or quality of the information presented. In addition, not all people will raise issues when given the opportunity.

Successful programmes may also cause expectations to be prematurely raised in the community about the proposal and possibly lead to financial and other commitments being made within the community before all necessary approvals have been obtained.

4. Environmental impacts and management

It is apparent to the Authority that this proposal has benefits both economically and socially and has attracted significant support, being based on important environmental objectives related to recycling and using renewable resources, as well as encompassing decentralised development into a rural community.

It is also evident to the Authority, and is clearly recognised in the PER, that there are areas and issues related to the proposal about which more information and data is necessary. This particularly applies to the proposed mill site, but some significant infrastructure and service components are also yet to be finalised. The approach adopted in the PER was to present existing information and to offer details of options available where decisions have yet to be made or to undertake to obtain more information as part of any approval given.

In responding to this approach, the Authority has considered the following environmental issues as being significant to the proposal outlined in the PER:

- soil conservation effects arising from the annual harvesting of cereal straw for pulp production;
- the impact that significant increases in the level of transport associated with the mill could have;
- management of potential social impacts;
- atmospheric discharges from the mill;
- solid waste disposal; and
- consequences of saline effluent disposal on the groundwater and soils of the mill site and surrounding land.

Each of these and other environmental issues are addressed in the remainder of this section of the report.

With regard to two general issues, soil conservation and good farming practice aspects associated with cereal straw retention and harvesting, and the potential environmental effects associated with effluent disposal as proposed in the PER, the Authority sought additional information from the Department of Agriculture and the company respectively. The response by the company to this request is presented in Appendix 3 while information provided by the Department of Agriculture is incorporated in the Authority's report.

The mill will require pollution control licences for emissions of dust, noise, other air emissions and solid and liquid wastes. The outstanding technical issues, which mainly require detailed design, will be resolved through that approval process.

Based on its assessment of the proposal, additional information provided in the public submissions, the company's response to the public submissions and further clarification of issues by the proponent and government agencies, the Authority recommends as follows;

Recommendation 1

The Environmental Protection Authority has concluded that the proposal to construct and operate a straw pulp and paper mill near Moora, as modified during the process of interaction between the proponent, the Environmental

Protection Authority, the public and government agencies that were consulted, is environmentally acceptable.

In reaching this conclusion, the Authority identified the main environmental factors requiring detailed consideration as:

- **soil conservation aspects of straw harvesting;**
- **transport;**
- **solid and atmospheric emissions; and**
- **effluent disposal and plantation management.**

The Environmental Protection Authority notes that these environmental factors have been addressed adequately by environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations given in this report.

Accordingly, the Environmental Protection Authority recommends that the proposal could proceed subject to the Environmental Protection Authority's recommendations in this report, and subject to the proponent's commitments to environmental management as detailed in Appendix 1 of this report.

The Authority's experience is that it is common for details of a proposal to alter through the detailed design and construction phase. In many cases alterations are not environmentally significant or have positive effects on the environmental performance of the project. The Authority considers that such insubstantial changes should be provided for within the assessment process.

The Authority also considers that any approval for the proposal based on this assessment should be limited to five years. Therefore, if the proposal has not been substantially commenced within five years of the date of this report, then such approval should lapse. After that time, further consideration of the proposal should occur only following a new referral to the Authority.

4.1 Cereal straw harvesting

The removal of cereal stubble from agricultural land is considered to have a number of advantages as well as disadvantages. These are outlined in more detail in Appendix 4, the submission on the PER by the Department of Agriculture. This submission clearly points to the need to retain a short length of stubble (about 10cm) after harvesting rather than its complete removal, to prevent soil and wind erosion and to provide feed for grazing stock. Moreover this level retained should be doubled if the farmer intends to immediately recrop the same ground.

Advantages of stubble removal for crop management include:

- eliminating the need to employ other removal or avoidance methods, such as burning, grazing and/ or raking;
- enhanced rainfall infiltration;
- easier and more efficient control of weeds;
- easier and cheaper crop seeding operations; and
- provision of an additional farm income source.

There are also other effects resulting from the the removal of straw that may not be beneficial for soil values, such as:

- increasing the likelihood of soil degradation by wind erosion on susceptible soils;
- physical impact of straw harvesting on sandy soils;
- potential for reduction in soil organic matter; and
- loss of nutrient in the straw, including potash.

This proposal would lead to a significant increase in the amount of cereal straw harvested in the State. Current estimates are that approximately 40,000 tonnes of cereal straw are harvested for other purposes, including stock feeds and mushroom growing medium. This increase would occur within a relatively restricted area, within 150km of Moora. However, as indicated by the company in the PER, straw contractors are more likely to harvest from sites with high straw yields rather than low. Contractors are unlikely to harvest on sites yielding less than 0.75 tonnes of straw per hectare (PER, p 22). The level of yield will be lowest on sandy surfaced soils.

The Department of Agriculture has indicated that straw harvesting presents a lower risk of wind and soil erosion on the Red Brown Earths (York Gum soils), Solonised Brown Soils (Salmon Gum soils) and Lateritic Podzolic soils with ironstone on the surface. These are generally found to the north, south and east of Moora (Stoneman, 1990). Soils with a sandy textured surface are not considered suitable by the Department of Agriculture for straw harvesting due to their high wind erosion risk.

A number of submissions expressed concern about the effect of harvesting on the nutrient status of the soil. As indicated in Appendix 2 and Appendix 4, the contribution of the straw to loss of nutrients is considered to be minor. Normal farming practices, including the application of fertilisers and use of legumes, compensate for any loss, albeit at a cost. Research undertaken by the Department of Agriculture at the Chapman Research Station has indicated that there are no significant differences in the percentages of total nitrogen and organic carbon in the top 10cm of the soil following burning of straw or its incorporation in the soil. South Australian research under similar conditions has shown a trend to lower soil nitrogen and carbon where stubble is burned compared to where it is retained, and a reduction in long term crop yields (15 per cent over 5 years) when used in continual cropping management. Overall, the harvesting of the straw would be expected to have less deleterious effect than burning.

Removal of straw from sandy soils may lead to a reduction in the already low status of potash. Where this may occur, the Department of Agriculture would recommend against straw harvesting. Although potash deficiency is unusual on the heavier soils, farmers would be recommended to monitor potash levels in the soil where cereals and straw are harvested over long periods.

Concern has been expressed about the possible effect of stubble removal on soil moisture. If there is an effect, it is most likely to be related to the surface soil conditions affecting infiltration of rainfall, soil evaporation, or runoff rather than on the ability of the soil to hold water.

Another issue that needs to be considered during the long term operation of the mill is the possibility that, during some years, straw requirements of the mill may exceed the volume of straw that can provided without leading to soil conservation impacts. While the PER indicates that this is unlikely, some contingency plan may be necessary to cover such a circumstance.

The PER suggests that the current stubble cutting procedures are expected to be used prior to baling. The three methods are cutting stubble at the time of grain harvesting, recutting the stubble after harvesting, or raking. The last of these is expected to be the dominant form of cutting in sheep grazing areas (PER, p 21). In its submission, the Department of Agriculture advised that harvesting methods that cut and bale straw (without raking) are to be preferred. The elimination of grazing after harvest and the adoption of minimum disturbance crop establishment practices are also preferred. The timing of the harvest would also be important. These management options would minimise the disturbance of surface soil and hence its erodibility (Appendix 4).

Responsibility for the management of this important aspect of the proposal rests with the owners of land from which straw would be harvested, the company and the Commissioner for Soil Conservation. It is essential that appropriate procedures are implemented to ensure that the risks to soil conservation of the project are minimised. The Soil and Land Conservation Act

provides mechanisms that could be applied to achieve that objective. In particular, the Department of Agriculture and Land Conservation District Committees have a responsibility to encourage farmers to apply sound management practices. However, the company would be expected to co-operate and support their effort. One way the proponent could do this would be to encourage the use of forage harvesters, in preference to mowing, raking and baling the straw. The company has indicated that it would be its intention to maintain a close liaison with the Department of Agriculture and the farming community with respect to potential straw harvesting impacts. This liaison has already commenced and plans to continue it are presently being developed.

Recommendation 2

The Environmental Protection Authority recommends that the proponent, in conjunction with the Commissioner for Soil Conservation, should prepare straw harvesting guidelines and implement procedures to ensure that soil conservation concerns are minimised. Issues that should be addressed in those guidelines include:

- **prevention of straw harvesting on unsuitable soil types;**
- **detriment to the soil by avoidance of continual removal of stubble from the same area;**
- **minimum length or volume of stubble to be retained;**
- **prevention of spread of crop diseases;**
- **time of harvesting;**
- **straw condition;**
- **method of harvesting, including the avoidance of raking; and**
- **reduced availability of straw below normal mill requirements.**

In each of the first three years of operation the proponent should obtain a report from the Commissioner for Soil Conservation regarding the implementation of the straw harvesting guidelines, to the satisfaction of the Environmental Protection Authority. In the long term the Commissioner for Soil Conservation should monitor and report on the effectiveness of these guidelines through the annual report required under the Soil and Land Conservation Act.

4.2. Transport

This proposal would generate a significant volume of transport. All the straw, waste paper and process chemicals would be carried to the mill by road. In addition, while the company has indicated a preference for the pulp and paper product to be carried on rail, road transport would be used if that were the most economic. The Moora Paper and Pulp Company Pty Ltd is currently exploring opportunities for the use of rail, including the construction of a rail spur to the mill site. The implementation of a direct railway link would reduce the proportion of heavy transport movements by 25 per cent, with consequential improvements in road use convenience and safety, and potentially minimise the long term increase in road maintenance costs.

Use of road transport may lead to the need to upgrade portions of the major roads and place additional pressure on local roads in the region. The Main Roads Department (MRD) has indicated that, in terms of the transport requirements of raw materials and product, consideration would be given to the approval of B-Double combinations (trucks with a trailer using a common set of wheels in the middle) between Fremantle and Geraldton along acceptable routes. The use of B-Doubles on local authority roads required for straw cartage

would need to be assessed on a road by road basis. The agreement of the appropriate local authority would also need to be obtained.

The approval of the use of the B-Doubles would be subject to evaluation of the upgrading requirements of the routes and satisfactory negotiation with the company of an arrangement for the sharing of the cost of work. The works which may need to be undertaken include:

- construction of suitable intersections between the access roads to the mill site and the rail siding with the Moora-Dongara Road;
- installation of lighting at the above intersection if night time operation is required; and
- improvement of other intersections and railway crossings on local government roads that may be necessary for safe operation of the permitted vehicles.

The MRD is also prepared to consider the use of road trains up to a maximum of 33 metres length between Upper Swan and the mill site, along Great Northern Highway and the Moora-Dongara Road, and between the mill and Geraldton along the Moora-Dongara Road and Brand Highway. It is likely that the use of road trains would only be permitted if additional passing lanes were constructed on the Moora-Dongara Road. The company would be required to contribute towards the cost of these passing lanes.

In its submission, the Shire of Moora expressed the view that finished products should be transported to the sea port (whether Geraldton or Fremantle) by rail. This would be facilitated by providing a railway siding on the west side of the Midlands Road to enable loading of the paper and pulp products onto rail without requiring trucks to cross the road to the east side of the railway line. To load on the east side would mean a truck crossing the road approximately every 12 - 15 minutes during daylight. The Shire considers that it is safer to have a protected rail crossing than to have many trucks crossing the Midlands Road (Appendix 2). Should a railway siding be constructed to the mill, consideration should be given for some the chemical requirements of the process, including caustic soda, as well as waste paper, being carried to the mill by rail rather than road. This would reduce the number of heavy vehicle movements through a number of communities, especially Moora.

One material that would have to be delivered to the mill by road would be the straw. The Shire of Moora has indicated that farmers or companies contracted to, or responsible for, the delivery of straw to the mill site should be required to ensure that baling and transport methods are such that a minimum of straw pieces are lost en-route to the mill. This is particularly important where a straw delivery route passes through a townsite, such as Moora.

The proponent has given several commitments in Appendix 1 to undertake consultation and gain necessary approvals from local authorities and the Main Roads Department in relation to road transport routes and operations.

The Authority considers that there are clear advantages to the use of rail transport and this proposal, given its proximity to the Perth - Geraldton railway, could make use of it. However, there has been no specific environmental evaulation of the impacts of a rail connection to the mill site and the use of rail. Therefore, the Authority considers that the Government should investigate the construction of a rail spur and use of rail by the company.

Recommendation 3

The Environmental Protection Authority recognises the inherent advantages of rail transport and recommends that the Government investigate the feasibility of a rail spur into the plant site.

4.3. Plant design and operation

The generation of paper pulp from straw material is a well established technology, although this plant would be the first in Australia. As explained in the PER, the process is relatively unsophisticated, using simple and commonly available equipment and chemicals that are extensively handled within the State. The process does not present any significant risks and hazards, and provided appropriate standards and guidelines are adopted in their transport, containment and use, nor do the chemical and other process materials.

A number of issues were raised in submissions and the PER concerning the nature and extent of impacts related to the mills operation. Specific details on equipment performance were raised in some submissions. The company has indicated in its response that the design parameters of some major mill components, such as the rotary kiln, have not been determined at this stage and considerable design of the mill has yet to take place (Appendix 2)

Visual impact

One of the reasons why the company selected Location 2007 for the mill site was its setback from the Midlands road. In addition, a low ridge close to the site offered some screening. The current plan places the mill in the lowest point of the site, further reducing the mills visibility from the road. It is likely that the main plant stacks, associated with the gas flare, incinerator and boiler, would be partly visible from the road The highest portion of the ridge that runs to the south through Location 2007 can be seen from the road, but it may be part of the tree plantation.

As the plant would operated continuously, light spill during the night would be evident. The company has indicated in the PER that care would be taken to locating and directing lighting to minimise light spill outside the boundary. The growth of trees around the mill would further reduce direct light impacts, although the mill's location would be obvious during the night.

It is likely that all of the mill would be visible from one neighbouring residence, which is located about 3km from the plant but on higher ground. Screening by planted vegetation may reduce but not completely remove this intrusion.

Dieback disease and drainage

As indicated in the PER, some soil material would be carried from the farm on the straw to the mill. This movement of soil has the potential to introduce the dieback disease *Phytophthora cinnamomi* to this mill site. Land to the north, east and west of Location 2007 retains the native banksia woodland, suggesting that dieback is not yet present. The introduction of dieback would lead to the death of the woodlands, some of which is used for commercial flower gathering purposes.

The mill site would occupy approximately 24 hectare of Location 2007. Within that area, the straw would be unloaded, stored and then fed to the hammer mill. Some soil would remain in this handling area, while more would be rejected within the pulping process. In response to this concern, the company has indicated that the straw delivery and storage area of the mill would be sealed and the drainage of the area contained. The collected stormwater would be used in the pulp process (Appendix 3).

It is understood that the dieback fungus would not survive the pulping process, which involves a combination of moderate temperature (97°C or more) and high alkalinity (50 per cent caustic soda solution).

While this would address the control of the introduction and spread of dieback disease during the mill's operational phase, the movement of vehicles and soils onto the mill site during construction could present a problem. There are standard hygiene procedures that should be adopted throughout the investigation and construction phases of development of the mill.

Water supply

The mill is proposed to be supplied from a bore located approximately 4km west of Location 2007. Water demand for the mill is estimated in the PER to be 3400 cubic metres per day and would be drawn from the Leederville Formation, which is expected to yield water of low salinity. Two bores would be installed, with one on standby in case the other could not be used.

The Water Authority has advised that this volume, and more if necessary, would be available from the Leederville Formation and this abstraction should not lead to any unacceptable effects. In its submission, the Geological Survey suggested that the proposed bore site may need to be located further west to be certain of low salinity water. Construction of the water supply pipeline from the bores to the mill should not result in unnecessary vegetation clearance, either in road reserves or private property, and any excavations should receive appropriate rehabilitation.

4.4. Atmospheric emissions and solid wastes

A range of discharges to the air, as well as solid waste, would be generated by the mill. These would be subject to works approval and licence conditions issued under the Environmental Protection Act.

Atmospheric emissions

The energy required for the mill, in the form of electricity and steam, is proposed to be derived from imported fuel sources and from within the process. The plant would include an incinerator to burn the black liquor and coarse straw material from the straw pulping stage and sludge from the effluent treatment process, as well as collecting and burning methane derived from the enclosed anaerobic digestion phase of washwater treatment. The process wastes would not be sufficient to generate all of the plant energy requirements and either oil or gas would be used to supplement those sources.

The principal air emission generated in the process would be sulphur dioxide (SO_2), while the incineration of the process liquour would lead to particulate sodium carbonate in the stack. Sulphur dioxide can affect air quality if discharged in high concentrations. The predicted SO_2 emissions from the incinerator, comprising sulphur contributions from the oil (0.05 percent) and straw (0.04 percent), assuming all of the sulphur from the straw finds its way into the black liquor, would be less than 5 grams per second. This level of emission is relatively low in comparison to other sites in the State.

The nearest residence to the mill site is about 3km away. An estimate of the maximum hourly SO_2 concentration that might be experienced at the residence under normal operation conditions would be less than 10 micrograms per cubic metre of air. The maximum SO_2 level recommended by the Australian and New Zealand Environment Council (ANZEC) is 700 micrograms per cubic metre.

Assuming that the level of sulphur in the black liquor does not significantly change from that indicated above, and provided the design of the plant adopts appropriate stack heights and building layout to minimise plume downwash, the Authority does not believe that the SO_2 emissions would present an environmental problem. These issues would be addressed in the form of stack testing requirements as part of the works approval and licence to be obtained by the company in accordance with Part V of the Environmental Protection Act.

At this stage, it is understood that the proponent has a preference to use natural gas as a fuel source at the plant, in which case the level of SO_2 discharge would be substantially lower than those indicated above.

The other major potential air emission would be sodium carbonate. It is not expected that, with proper equipment design and operation, particulate emissions are likely to present a problem. The remoteness of the plant site to neighbouring residences ensures that they would not be affected and the company has indicated that it would install stack gas filtering equipment if required.

Odour

Odours are generally perceived to be a major problem associated with pulp mills. This comes from experience with older kraft paper pulp mills, which use chemicals to break down the cellulose in wood to produce paper. This plant uses a different process to free the fibres.

Some odour would be emitted from the plant. As indicated in Appendix 2, the company believes that the odour would be of low intensity and the distance to neighbouring residences should be sufficient to minimise any impact. An important part of the plant design that would virtually eliminate a common source of odour would be the enclosing of the anaerobic treatment ponds. The need to maintain oxygen levels in any deep ponds required to buffer effluent flows, which could represent an additional odour source, has been recognised by the company (Appendix 2). Additional control is provided by the enclosure of most of the process.

The Authority would expect licence conditions to be applied which would not allow odour impacts.

Noise

Although the plant contains some relatively noisy equipment, most would be contained within a fully clad building. Only the equipment located outside, such as mobile loaders and the hammer mill, are likely to be significantly noisy. The prevailing rural land use would normally have relatively low noise levels. In the case of this site, although the distance to the neighbouring residences should lead to acceptable noise levels at those points, the Authority considers that noise monitoring be performed prior to, and after, the plant is commissioned to confirm that noise levels at the nearest residences were indeed acceptable. The monitoring programme will be specified in detail in the works approval and licence to be issued for this proposal.

The mill would, along with the increase in transport associated within mill, especially heavy vehicle movements, raise the general background noise levels in the region. However, this should not lead to unacceptable levels.

Solid wastes

The pulp and paper mill would generate a number of solid wastes which would require disposal. Some soil material would be imported with the straw, other matter would be rejected from the wastepaper pulping stream and the incinerator would create approximately 16.4 tonnes per day of ash, mainly sodium carbonate. The PER contains a commitment to undertake a site identification study to determine the most suitable landfill site.

Sodium carbonate is relatively soluble in fresh cold water and therefore has the potential to produce leachate with high total dissolved solids under the influence of percolating rainfall or groundwater. In view of the relatively large quantities of this waste that would be produced (about 6,000 tonne per annum or about 9,000 cubic metres per annum), site selection would be important. In Appendix 2, the proponent has suggested that a suitable site is likely to be found in the vicinity of the mill where leachate generation and the potential for water contamination can be minimised

The company indicated in the PER that sodium carbonate has a range of potential uses and markets for the by-product would be actively sought. One of those uses, application to correct low pH soils, received comment from the Department of Agriculture. They advised that the idea of the sodium carbonate having some value as an amendment for acid soils requires investigation before it is promoted. In terms of neutralising value, it is roughly equivalent to calcium carbonate. However, the high percentage of sodium would induce undesirable dispersion of the clay fraction of soils. This would pre-dispose the soils on which it was applied to waterlogging and/ or runoff and erosion (Appendix 4).

4.5 Wastewater disposal and management of the tree plantation

The wastewater effluent would be subject to anaerobic and aerobic treatment prior to disposal by irrigation into the tree plantation. The PER indicates that the plantation would occupy approximately 110 ha and would comprise salt tolerant species, such as varieties of Eucalyptus camaldulensis. The company's response in Appendix 2 indicates that the area of the plantation could be expanded.

The plant would generate approximately 2800 cubic metres per day of treated effluent prior to discharge into the tree plantation. The treatment ponds would be lined to ensure that untreated effluent was not discharged and contaminate the groundwater. The effluent is expected to have the following quality characteristics after treatment:

CHARACTERISTIC	VALUE
Colour	1000 units Pt. Co
Total Dissolved Solids (TDS)	4500mg/L
Biological Oxygen Demand (BOD)	150mg/L
Chemical Oxygen Demand (COD)	750mg/L
Sodium (Na)	1550mg/L

It is noted that, in its response to the submission issue regarding COD, the company has indicated that additional effluent storage, in the form of shallow ponds or deeper aerated ponds, would be necessary to provide buffering capacity of flows (Appendix 2)

Because of the elevated salt level, the proposal requires that the tree plantation reduce water volume flow to the groundwater by no more than 50 per cent. Due to this operational requirement and the reduction of effluent volume resulting from evapotranspiration by the vegetation, the salinity level of the effluent is predicted in the PER to increase to 9,600mg/l in the groundwater.

Groundwater levels and quality

Little information is available in relation to the level and quality of the groundwater at the mill site. The PER acknowledges that the company has undertaken minimal on-site investigations and has used regional based information to interpret groundwater conditions.

Location 2007 has been cleared but is regenerating. The soils are generally shallow sand over gravel. It is surrounded on three sides by Banksia dominated vegetation (mainly *B prionotes*) on private property. Beyond the woodland to the east, south and west, cleared farm land within 500m of the plant site has areas affected by waterlogging and salinisation, on slopes as well as in depressions. The water table in the general area is presently 0.5 - 3.0m below the surface but rises in winter. Water quality at the water table is generally fresh near the surface, but TDS increases rapidly with depth within the superficial aquifer.

To provide more information on the site, the Department of Agriculture installed a piezometer nest in a dunal swale adjacent to the eastern boundary of Location 2007 in March 1991, with the deepest hole being drilled to 20 metres. The top 3 metres comprised yellow sand over consolidated mudstones and clays. A seasonal watertable perched on these mudstones and clays recorded a salinity of approximately 4350mg/l, at a time of the year when the salinity level would be at its highest. From about 5 - 7 metres there are hard dry mudstones confining the next aquifer at about 7 metres depth. The aquifer recorded a salinity level of approximately 5100mg/l. High yielding sands, with a groundwater salinity level of approximately 4000mg/l was found at about 17 - 20 metres. The details of this set of bores is presented in the figure attached to Appendix 4.

Average annual rainfall at Moora is 461mm. Appendix C to the PER indicated that the disposal of the estimated 2809 cubic metres per day of wastewater over an area of 150ha on Location 2007 would represent less than 700mm per year. The PER itself adopted a plantation area of 110ha, which would mean that annual application of effluent in the plantation would be approximately 930mm per year. This is still substantially lower than the excess of average evaporation over average rainfall. The PER indicates that the effluent would be irrigated by spray. This option should be carefully evaluated against a trickle system, which has better application control and is not restricted by increasing tree height but can be subject to clogging if solids are present in the effluent.

Based on the limited on-site information available, the authors of Appendix C made several observations in relation to irrigation disposal on Location 2007. The first was that the site would have a high capacity for wastewater disposal by spray irrigation, with the deep sands expected to have an infiltration capacity of more than 1000mm. Secondly, there may be a shallow layer of fresh groundwater beneath the sand ridges, but the deeper groundwater is expected to be brackish or saline. This has been supported by the information from the Department of Agriculture bores. Thirdly, the capacity of the aquifers in the sands and deeper strata to carry additional recharge resulting from the irrigation of the wastewater is not known, but a shallow water table could develop beneath the lower portions of the site and this could become saline. Fourthly, a shallow water table or strata beneath the site may impede drainage. Again, this is consistent with the information from the Department of Agriculture bores.

Following a review of the available information, albeit still limited, the Authority concluded that there is the potential for adverse environmental impacts to result from the disposal of wastewater. This conclusion is based on the following factors:

- the irrigated wastewater is expected to increase the salinity of the shallow groundwater, and would contain high colour levels. It is anticipated that the majority of the BOD, organic matter and suspended solids within the wastewater would be removed by natural soil filtration and biological degradation;
- there appears to be an aquitard at shallow depth (approximately 3m) beneath the site, which would tend to limit the vertical movement of the saline irrigated wastewater and encourage its horizontal movement;
- while it is believed that the predominant groundwater flow would be to the east, towards the Coonderoo River, it is likely that some flow would be to the west as well;
- there are sites on private property located to the east and the west of Location 2007 which suffer from waterlogging and subsequent salinisation. Some of these are still developing;
- a rise in the groundwater level beneath the Location 2007 would probably lead to increased groundwater levels on adjacent land, particularly to the east, west and north, and exacerbate current land degradation problems. This land is not owned by the company and is used for grazing, grain cropping and wildflower cultivation, as well as being retained in its natural condition; and
- the company should be responsible for minimising and managing any impacts that arise as a consequence of the project within as well outside of Location 2007.

At the request of the Authority the company has provided strategies for addressing these concerns. This is presented in Appendix 3 and additional commitments have been given in Appendix 1. In summary, the company accepts the possibility of off-site groundwater related impacts and has outlined a series of actions intended to minimise the risk of their occurrence. These include:

- establishment of a groundwater monitoring network to detect changed conditions;
- the determination of criteria defining environmentally acceptable change;
- construction of a drain or bore network along the boundary of Location 2007 to restrict any groundwater increase to the agreed criteria, discharge of this drainage water to either the pulp process or the Coonderoo River when it is flowing;
- the company would undertake any necessary reclamation work;
- provision of a replacement potable water supply should current domestic supplies be affected by the project; and
- controlling groundwater effects within Location 2007.

The Authority would expect that any detrimental effects on stock water supplies attributable to the mill would also be addressed by the company.

The company's response has restated the possibility of discharging effluent contaminated groundwater into the Coonderoo River (Appendix 3). This suggestion was also made in public submissions and in the PER. There is very limited information available on the flow regime, quality and beneficial uses of the River. The catchment of the River contains several salt lake systems up stream and downstream of Location 2007 and the fringing vegetation near the mill site reflects saline water and soil conditions. It is understood that the River generally only flows during winter, with high tannin salt levels in the early flows which decline once flow is well established. Wetlands downstream of the plant site are known to possess important waterbird usage values. The Water Authority has indicated that, should there be discharge to the River from the operations of the project, any discolouration beyond ambient levels may require action by the company and no affect on existing beneficial uses would be acceptable (Appendix 2). It is important that the beneficial uses of the river are fully defined if discharge to the Coonderoo River is considered or likely.

Discharge to the Coonderoo River should be carefully considered. The Authority would prefer to see the groundwater that is gained from a proposed drainage programme returned to the process stream. It is likely that the time of greatest and cleanest flow in the river would coincide with the groundwater being near its highest level and possibly at its least coloured and lowest salinity, due to dilution effects from rainfall. Under these circumstances, it may be possible for some disposal to take place into the River. If this were to occur, specific criteria would need to be developed to ensure that beneficial uses were not affected. These criteria would need to included in any approvals given under Part V of the Environmental Protection Act.

Contamination of deeper aquifers

Several submissions pointed to the proximity of Location 2007 to the Darling Fault and expressed concern about the possibility of contamination of the deeper aquifers, including the Leederville Formation, arising the irrigation of the effluent.

Advice from the Geological Survey of WA and Water Authority is that, while limited information is available, such contamination is unlikely. Data from a site to the north of Location 2007 suggests that the Leederville Formation discharges into the salt lakes associated with the Coonderoo River (Appendix 2).

Tree plantation management

As an integral and important component of the project's effluent disposal strategy, it is essential that the tree plantation is successful. This means that species selection, site selection within Location 2007, tree establishment, irrigation design, and tree plantation maintenance over the long term, must be undertaken according to a defined but evolving programme. This is the intent by the proponent in commitment 4 (Appendix 1).

One submission suggested that trials be conducted with preferred tree species watered with "synthetic wastewater" to determine their ability to survive the irrigation regime. In Appendix 2, the company has indicated that the potential benefits of operational trials after plant start up involving finally selected salt-tolerant species is recognised. The Authority is of the view that it is important that the tree plantation be treated as a priority, especially species selection and plantation establishment. Both would need to take account of the nature of the irrigated effluent to maximise performance. Trials should be undertaken as soon as approvals are obtained and not after plant startup, given that the plantation will need to be effective at reducing the extent of groundwater recharge from the time of commencement of the mill's operation. It is likely that the plantation would need to be planted as soon as possible, and certainly at least one year prior to effluent irrigation, to minimise the risk of substantial tree death. This would require a watering strategy to be in place through at least the plantation's first summer as effluent would not be available. This water strategy may be different to the effluent disposal regime and would need to be accommodated in the tree plantation management programme. Clearly, establishment of the plantation would need to be integrated into the detailed plant design. The company's commitment to the tree management programme needs to address the worst case scenario of the tree plantation not surviving or its function being significantly diminished, due to disease, pests or poor growth.

Some suggestions have been made that the availability of the effluent and land provides the opportunity for a number of different plant species to be irrigated, even to be cropped. While this may be possible and even desirable, given that monoculture systems may be more susceptible to the effects of disease or pests than diverse systems, it is essential that the performance criteria determined for the plantation are applied to all species. These criteria should be included as part of the effluent disposal and tree plantation management programme to be developed under commitment 4 (Appendix 1)

Recommendation 4

The Environmental Protection Authority recommends that the effluent disposal design, management and contingency strategies to be prepared and implemented by the proponent should ensure that potential on-site and off-site impacts arising from the operation of the mill, including

- **waterlogging and/ or soil salinity,**
- **loss of productivity of affected neighbouring properties,**
- **contamination of domestic and stock water supplies,**
- **failure in part or whole of the tree plantation as an integral part of effluent disposal,**
- **dieback disease spread, and**
- **contamination of the Coonderoo River,**

do not arise or are mitigated, to the satisfaction of the Environmental Protection Authority on the advice of the Water Authority of Western Australia and the Department of Agriculture.

4.6 Social monitoring

The company has made a number commitments in relation to the community, including the continuation of the public liaison programme with the local community, especially neighbours, and endeavouring to maximise employment and service provision opportunities within the Moora and district community. These commitments should be monitored through a social monitoring programme implemented by the company.

It is expected that, with the continuation of the community and local authority consultation, the project would provide significant benefits to the local community. The project may, however, place portions of the community and service related infrastructure under some pressure at various times, particularly during construction and early operational stages. The effects of the project should be monitored by the proponent, in conjunction with the Shire of Moora. This may assist in the anticipation of specific problems arising and their effective mitigation.

The choice of accommodation for the construction workforce will give rise to a number of issues. Given the small amount of short term accommodation available and the inexperience of the town of Moora in dealing with a relatively long term construction workforce, careful management will be required. Should a construction camp be required, the location and management of the camp would have a significant effect on the town of Moora and the site's neighbouring properties. In particular, the management of the construction period should take into account the likely effects of a concentration of non-permanent workers in Moora.

The company has committed to a local recruitment policy for the proposal. However, it is difficult to estimate how many of the estimated 65 plant related jobs would be taken up by local people. It is also unclear how the employment generated by straw collection and transport would effect the population of Moora. These factors have made it difficult to estimate the likely population growth in Moora as a result of the project. A social monitoring programme should follow up these issues to ensure that any population growth felt by Moora is managed in terms of impact on infrastructure, facilities and services.

Recommendation 5

The Environmental Protection Authority recommends that the proponent implement a social monitoring programme, in consultation with the Social Impact Unit.

4.7 Planning

The proposed mill site is currently zoned for rural purposes under the Shire of Moora's Town Planning Scheme No. 3. Implementation of this proposal would require Location 2007 to be rezoned to a more appropriate industrial related zone. This rezoning would need to be initiated by the Shire of Moora and approved by the Department of Planning and Urban Development and the Minister for Planning.

The Authority's advice on the environmental impacts associated with this proposal in no way should be seen to pre-empt this planning approvals process.

References

Halpern Glick Maunsell Pty Ltd (1991), Straw Pulp and Paper Mill, Moora - Public Environmental Review

Stoneman, T C (1990), An Introduction to the Soils of the Moora Advisory District. Western Australian Department of Agriculture, Bulletin 4182

Appendix 1

Proponent's commitments on the proposal

SUMMARY OF COMMITMENTS BY THE PROPONENT

The proponent undertakes to fulfil the following Commitments, in accordance with applicable State laws and regulations and with standards and procedures set out herein or as otherwise agreed .

1. The proponent will, as part of the project design phase, apply for and obtain a Groundwater Extraction Licence from the Water Authority of WA to extract water from the Leederville Formation. A separate licence will be obtained for each and every bore to be constructed. The proponent will also design and implement a groundwater monitoring system to the WAWA's satisfaction, with the following principal elements:

   - metering of all water extracted with cumulative annual extractions given.
   - chemical analysis of major ions in the water initially at three monthly intervals.
   - monthly standing water levels will be taken.
   - monthly salinity (T D S) levels will be measured by conductivity.
   - construction details of the bore will be submitted to the Water Authority of WA for approval before construction commences.
   - the annual report will also provide details of water levels and drawdowns in other bores in the aquifer, the only known bores at this time being those that supply Moora.

   Monitoring reports will be prepared on an annual basis and presented to the Water Authority of WA by the proponent accordingly for review and approval.

2. The proponent will, as part of the detailed mill design, undertake a detailed site investigation program to confirm the existing characteristics of the shallow aquifer and particularly the quality of water drawn by neighbouring properties.

   The proponent will undertake detailed hydrological studies in relation to washwater disposal. The studies will identify:

   - the detailed shape and direction of flow of the current superficial aquifer;
   - the potential rise in groundwater levels due to washwater application;
   - changes to flow directions of groundwater due to the mounding effect of washwater application;
   - the expected shape and movement of the saline and coloured water plume away from the site;
   - any potential areas where the altered water table may intersect ground surface leading to seeps and salt scalds.

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These theoretical analyses and predictions will be checked during operations by the proposed monitoring programme. If it is found that seeps and scalds develop action will be taken to install shallow drains, slotted agricultural pipes or even dewatering spears to alleviate the problem.

The proponent will also install permanent monitoring bores at strategic locations on the site and on adjoining properties prior to mill commissioning. A comprehensive shallow aquifer monitoring system will also be designed and implemented by the proponent as follows:

A network of bores will be installed around and within the mill site at least 12 months before mill operation begins. The depth and location of these bores will be determined in consultation with the Water Authority of WA.

A baseline monitoring program will be implemented based on these bores with measurements taken at 1 monthly intervals of:

- standing water levels
- salinity (TDS) levels
- colour
- pH
- nitrogen
- phosporus

Bores will be installed to allow measurements at selected locations to be taken in the upper, mid and lower levels of the aquifer.

- Major ions analyses will be taken at three monthly intervals.

- After start-up of the mill all measurements will continue to be taken at 3 monthly intervals over the first twelve months. Subject to a satisfactory review with the Water Authority of WA, monitoring will then continue at six monthly intervals.

- Monitoring stations will be set up on the Coonderoo River (one immediately downstream of the site and one in the nearest salt lake downstream of the site) and one on the Moore River close to and downstream of its junction with the Coonderoo River. Similar water quality parameters and test intervals to those outlined above for the superficial aquifer will be implemented.

- The above mentioned data will be included in an integrated report submitted to the Water Authority of WA and EPA on a twelve monthly basis for review and approval.

In addition to the monitoring system related to the effluent disposal system there will be additional groundwater monitoring bores installed to permit monitoring of groundwater qualities in close proximity to the anaerobic and aerobic lagoons. It is anticipated that these bores will be located such that monitoring for signs of leakage from the caustic soda and crude oil tanks can also be undertaken.

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These bores will be installed as part of the mill construction effort and monitored before commissioning to give baseline water quality data and then at six monthly intervals. Results will be collated and if signs of contamination are found results will be reported to the EPA immediately. The investigation and monitoring programes will be to the satisfaction of EPA and WAWA.

3. The proponent will formulate a contingency plan to the satisfaction of EPA and WAWA designed to ameliorate any adverse impacts on shallow groundwater resources used by neighbouring farmers. The results of detailed site investigations and monitoring of groundwater behaviour will be used to formulate such a contingency plan should this be considered necessary.

The Proponent will:

- liaise with WAWA and EPA to develop criteria for acceptable changes of water level in monitoring bores around the peimeter of the site and on neighbouring properties

- install a drainage system around the perimeter of the site if water levels in monitoring bores increase beyond the agreed maximum as a result of effluent disposal from the plant:

- undertake actions to lower groundwater levels in off-site areas if monitoring bores show that the water levels have increased above the agreed maximum as a result of effluent disposal from the plant;

- provide an alternative domestic supply if monitoring shows that the water quality at a neighbouring farm falls below guidelines established by the NHMRC as a result of effluent disposal from the plant

4. The proponent will, as part of the detailed mill design, formulate and implement an effluent disposal and tree plantation management program including a detailed site investigation and soil analysis program as follows:

- a full site investigation including detailed soil analysis and local groundwater levels,
  evaluation of likely chemical interactions between the soil and the effluent,
- choice of salt tolerant species,
- detailed water balance studies,
- development of detailed watering schedules and consequent design of the irrigation system,
- formulation and implementation of a detailed tree growth and health monitoring program.

The Moora Pulp and Paper Company Pty Ltd will implement this program as part of the mill design, construction and operation phases as appropriate, to the satisfaction of EPA & WAWA.

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5. The proponent will, as part of the detailed mill design, undertake a detailed site identification study to determine the most suitable landfill disposal site for solid wastes generated by the mill. The study results will be presented to the EPA and the Shire of Moora for review and approval prior to commissioning of the plant.

6. The proponent will undertake detailed design of the mill to ensure compliance with noise level restrictions in accordance with the EPA Act, 1986. Mill performance in this regard will be to the satisfaction of the EPA.

7. The proponent will undertake detailed design to ensure compliance with acceptance criteria for atmospheric emissions generated by the mill and particularly with respect to sulphur dioxide, dust and sodium carbonate emissions in accordance with criteria dictated by the EPA. The proponent will formulate and implement an emission monitoring programme to the satisfaction of EPA that will measure sulphur dioxide, dust and sodium carbonate emission levels on a monthly basis until and unless longer monitoring periods are agreed with the EPA.

   Reports on the results of the emission monitoring programme will be presented to the EPA on a six monthly basis for review and approval unless adverse results are recorded in which case the incidence will be immediately reported to the EPA.

8. The proponent will formulate and implement a detailed decommissioning, facility demolition, site cleanup and rehabilitation of tree planation maintenance programme at least 5 years prior to mill operations ceasing. All procedures and measures will be submitted for review and approval by the EPA before implementation.

9. The proponent will continue a public liaison programme within the local community and particularly with the immediate neighbours to the mill site and the Shire of Moora. This liaison programme will be undertaken in an ongoing manner to ensure relevant details of the project are explained to the local community and that the public is aware of progress on the project through the design, commissioning and operating phases.

10. The proponent will endeavour to maximise employment from within the local community with respect to this project. Results of these efforts will be reported to the Shire of Moora upon commissioning of the mill.

11. The proponent will endeavour to maximise the use of services from within the local community with respect to this project. Results of these efforts will be reported to the Shire of Moora on an annual basis or as otherwise agreed.

12. The proponent will liaise with the EPA and the Shire of Moora during the preliminary site construction phase to define a suitable construction camp site if provision of such a facility is deemed to be necessary. Agreement of both parties will be obtained before a camp is established for the project.

13. All transport operations will be carried out in accordance with well established procedures and government regulations. The proponent will discuss and agree Straw transport routes with the appropriate Shire Council and other relevant authorities.

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14. The proponent will formulate and implement a vermin control program.

15. The proponent will incorporate into the mill design:

- sealed road sites for straw delivery;
- straw delivery area to be drained to sump, and runoff added to process stream;
- design and management of plant to prevent contamination of wastewater stream by any Phytophthora from straw delivery area;

Appendix 2

Issues raised during the public review period and response by the Proponent

MOORA PULP AND PAPER COMPANY PTY LTD
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20 May 1991

Ref: W2.6-060

The Chairman
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

Attention: Mr Colin Murray

Dear Sir

MOORA STRAW PULP AND PAPER MILL
PUBLIC SUBMISSIONS - AMENDED WRITTEN RESPONSE

Please find attached our amended response which addresses your verbal comments expressed during our telephone discussion Tuesday, 14 May 1991.

Thank you for your assistance with this matter.

Yours faithfully

FORD T MURRAY
General Manager

PUBLIC ENVIRONMENTAL REVIEW

STRAW PULP AND PAPER MILL

MOORA

FEBRUARY 1991

PROPONENT'S RESPONSES

TO

PUBLIC SUBMISSIONS

MAY 1991

INTRODUCTION

During the public review period of the Public Environmental Review of the proposed straw pulp and paper mill at Moora a number of submissions were received by the Environmental Protection Authority (EPA). These submissions were provided by members of the public and various Government authorities.

The EPA have summarised the principal comments and issues raised in each of the submissions. The submissions have also been categorised under the following broad headings:

1. Project and Objectives
2. Process and Infrastructure
3. Raw Material Collection
4. Transport
5. Effluent and Other Emissions/Wastes
6. Monitoring
7. Other Issues

Details of the various comments and issues raised are given below together with responses from the Proponent where a response is deemed to be warranted.

RESPONSE TO SUBMISSIONS

1. PROJECT AND OBJECTIVES

a) Supportive Comments

1.3 Overall the consultants have produced a report which addresses the guidelines.

1.5 Real opportunities for advancement of the goals of the Wheatbelt Aboriginal Corporation in regard to the development of enterprise areas is a district possibility as well as employment during the construction phase and operation of the mill. The Wheatbelt Aboriginal Corporation are fully supportive of River House is regard to the development of the mill.

1.6 The Conservation Council would like to congratulate the proponents for the thought and effort they have put into consultation with the community. We would strongly recommend that other proponents practise a similar method of consultation when developing a project, it has saved a great deal of time and we believe has been beneficial to both the community and the proponents.

1.7 The Fremantle Port Authority strongly supports the project.

1.9 The project will have a minimal effect on the environment and the proponent's land rehabilitation and monitoring of environmental impact procedures are a model for all Australians to follow. The paper mill is an industry which is compatible with the region.

1.10 The value added (manufacture of paper) component of the project is a most welcome initiative and one which is being promoted by economists, industrialists and Government.

1.11 The WAFF would like to express its support for the proposed project at Moora.

1.13 This mill will provide a substantial boost to the economy of Moora. It will employ directly and indirectly over 260 people in the Moora district and will earn Western Australia 60 - 70 million export dollars annually. The importance of such economic benefits cannot be over stressed in the current rural crisis, which is why the project has received so much support from the community.

1.15 The project will:

- *create approximately one job per 1000 tonnes of straw collected;*
- *provide opportunities for full-time employment;*
- *generate funds derived from straw collection which will pass through the local commercial economy;*
- *provide opportunities for farmers and existing contractors to become involved in collection or transportation; and*
- *generate additional income to growers.*

1.16 Council is very supportive of this project and our many discussions with the proponents have been very positive and helpful and all matters which have been raised with the Company have been "taken on board', investigated or researched and responded to the satisfaction of the Council.

1.17 The project enjoys the support of the community and I add my endorsement, subject to the environmentally satisfactory disposal of waste, and acceptable resolution of other environmental matters raised by the Shire of Moora.

1.19 I, and I believe the community, accept the environmental impact will be minimal. The benefits of the mill, being the revitalisation of economic activity and employment, heavily outweigh the environmental aspects. Also, the fact that the mill will provide for incorporation of waste paper will be welcomed by the area it would serve.

1.23 The Geraldton Mid-West Development Authority supports the proposal to establish a pulp and paper mill close to the town of Moora. It is the view of this Authority that the proposal meets Government policies with respect to sustainable development while offering considerable economic, employment and decentralisation benefits to central Midlands and Mid-West areas.

No response required.

b) Site Selection

1.1 A site closer to the town within cycling distance or where the wife can have the car after driving the husband to work would be preferable.

1.12 The proposed site should not be used in the proposed manner. The Proponent should seek an alternative site and devise a method of effluent disposal where seepage cannot occur and a more streamlined transport system can be used.

1.14 An alternative site, south of the Moora Golf Club, is suggested. This site is owned by Moora Council, is 3km from the town, and wastewater could be directed into Lake Dalaroo for evaporation as well as having the opportunity to irrigate the golf course and providing a water ski, etc venue.

1.18 Why is the company at pains to put the mill out of the sight of the general public if it as environmentally friendly as the proponents would have us believe.

1.20 Industrial waste has ruined the rivers of Europe. Must we copy their stupidity. Far better to site the mill on a stable site and utilise evaporation ponds than to knowingly endanger soils.

The rationale for site selection is outlined in Section 3.5 of the PER and as stated, sites other than the selected site were identified as being technically and economically feasible. However, the selected site is considered by the Proponent to be the most attractive site when assessed against the full range of factors.

c) Site Investigations

1.2 Generally, the proposal is considered sound in terms of the elements relating to water supply, usage and wastewater disposal. The major criticism of the proposal would be that many assumptions have been made about the site without physical site investigations being undertaken.

It is considered that sufficient is known about the site characteristics to provide an acceptable level of confidence regarding assumptions made. The proposal also provides sufficient opportunities for the Proponent to respond to unforeseen circumstances without compromising the feasibility or integrity of the project. Additional comment in relation to a contingency plan is addressed elsewhere in this response.

d) Local Box Production

1.4 Production of finished cardboard boxes for local use could be considered. This could increase employment and be an import replacement.

River House has recognised the opportunity to produce finished cardboard boxes for local customers. Accordingly the company is proceeding with developing a proposal to establish an operating box plant at Perth in 1992.

e) Project Economics

1.8 The earnings in the PER are gross anticipated earnings and do not take into account expenditure overseas. Consideration should be given to the costs of trucks, balers, increased fertiliser and spreading costs to the balance of trade figures. Also consideration to interest payments for mill is borrowed overseas.

The Proponent notes this comment.

f) Exports

1.21 It is anticipated that all pulp will be exported through the port of Geraldton while paper products will be exported through Fremantle and Geraldton.

This comment is quoted from the PER. The final selection of the port is a matter for detailed negotiation.

g) Further Information

1.22 It is pleasing to be able to say that subject to the comments in relation to the need for more information on black liquor and washwater quality, sodium carbonate disposal, irrigation of wastewater stream, on-site power generation, black liquor incineration, transport of straw to the mill site and transport of the finished straw and paper product, the overall thrust of the project and the measures to be undertaken by the company to dispose of water and minimise dust, noise, odour are satisfactory to Council. Council requests further information from the Proponent regarding these matters. It is important that all environmental impacts are acceptable over the lifetime of the project.

The details requested are generally addressed elsewhere in these responses.

2. PROCESS AND INFRASTRUCTURE

a) Water Supplies

2.1 It is agreed that the effect on the Moora Town Water Supply wellfield is likely to be negligible.

2.2 Section 4.10.3 Licensing of the groundwater abstraction will be required. It is considered that adequate supplies of groundwater are available to provide a water supply for the 3,400kL/day required, plus at least an equal amount should dilution of the effluent water be required.

2.3 Section 7.2 Although leakage between aquifers has not been addressed, it is considered that due to the relatively small abstraction in proportion to the available reserves, and the lack of any other major users in the immediate vicinity, any effect is likely to be insignificant.

No response required.

b) Light Spill

2.4 The plant will be visible from nearby high ground to the east and west. What does the Proponent intend to do to minimise this problem, especially when it will be accentuated by lighting at night.

This is addressed in Sections 7.9.3 and 7.9.4 of the PER.

c) Chemical Storage

2.5 The proposed chemical storage is:

Sodium hydroxide solution	*250 kL*	*Class 8*
Condensate (crude oil)	*1,000 kL*	*Class 3.1*
Methane	*-*	*Class 2.1*
Ammonia	*Minor*	*Class 2.3*

An application to store dangerous goods will be required by the Department of Mines for each of these products.

2.6 The chemicals stored on-site are well known to the general public and would not attract any public comment.

No response required.

d) Fire Risk

2.7 The design of the plant indicates at least two internal combustion machines working in close proximity to straw. This would impose a fire risk during high temperature and later afternoon SW winds. If a fire was started the whole fire stack could be alight before the Moora Fire Brigade could assist. If only every second stack was used during summer, giving 45m between some improvement to fire risks could be achieved.

This is addressed in Section 6.2.10 of the PER.

e) Power Generation

2.8 Little detail is provided as to the characteristics of the power generation plant, other than to note that a co-generation scheme will be deployed. It would be beneficial to know more about the power generation plant, with particular reference to the oil fuel option and the following specifications:

- *height of the stack and its visibility from neighbouring land and other public visual sites; and*
- *visibility of the exit gas plume, in terms of colour, opacity and persistence.*

Preliminary design has not progressed to a stage where a decision on imported fuel can be made.

Detailed design of the stack and flue gas treatment facilities have also yet to be finalised. The principal parameters used in the design will relate to selection of a fuel source, prediction of the chemical constitution of flue gases and a detailed plume modelling analysis. The Proponent will ensure the plant design provides performance characteristics that do not cause unacceptable impacts on the environment or nearby neighbours to the facility.

The Proponent understands that a 35 metre stack and a particle atmospheric emission limit of 250 micrograms per cubic metre would be required should this proposal proceed. The Proponent will comply with this requirement.

f) Water Supply

2.9 The proposed borefield may be several kilometres too far east to be certain of low salinity water from the Leederville formation. Although GSWA indicate the selected area is surrounded by high quality, low salinity bores, some very brackish bores are also known to exist in the area.

It is acknowledged that there are variations of salinity of groundwater in the area of the proposed production bore and that the risk of encountering saline water reduces to the west. Detailed investigations will be undertaken by the Proponent to confirm adequate water availability at acceptable qualities.

g) Access Road

2.10 The access road to the mill site will have an impact on local fauna movement because:

- *a farm programme provides an area of semi-bushland for native fauna to move between the chert hills on the east to areas of sandplain heath adjacent to the mill site; and*
- *road noise, etc will interfere with the waterbirds and other fauna which use the bush fringe of the Coonderoo River.*

2.11 The building of the road will greatly inconvenience the movement of livestock on the affected property.

2.12 The road reserve between the Midlands Road and Prices Road has places with very fragile steep sand. Excavation or construction in these soils would cause it to become very loose and unmanageable.

2.13 There is no desirable road, bridge or other construction materials adjacent to the proposed road or plant site.

The plant access road is to be constructed within a gazetted road reserve. Construction of the road will utilise normally accepted practices and every effort will be made to retain native vegetation outside the limits of formation and drainage works. The reserve will be fenced on both sides to preserve the integrity of paddocks on adjacent properties. Topsoil removal and replacement techniques together with brush stabilisation will be used where necessary to ensure soil stability is achieved. Materials for road construction will be obtained from recognised sources to ensure adequate quality is achieved. This may involve importation of materials and has been provided for by the Proponent.

3. RAW MATERIAL COLLECTION

a) Observations

3.1 All farmers engaged in straw harvesting should aim to improve the soil mineral content. As the cost of additional fertiliser could be in excess of the price paid for standing straw, economic considerations should determine the volume of straw available.

3.3 Growers must receive a minimum of $10.00/tonne for making their straw available.

3.4 Harvesting of straw from the better soils in the region will not pose a wind or water erosion problem especially if the straw is cut 100mm above the ground.

3.5 Only collectors with a proven and reliable background in straw collection should be appointed, to reduce risks of paddock damage and business failure.

3.6 Poorer soils, light soils and deep-ripped paddocks will not be suitable for straw collection due to potential for wind erosion and non-accessibility to vehicles removing bales.

3.8 The fact that the straw being removed will mean the loss of nutrients within the soil will be balanced by the advisory services, allowing farmers to monitor precisely the standing of the soil. The payment received for the straw will compensate for its replacement.

3.9 Straw collection on farms has the following benefits:

- *is a means of reducing straw in paddocks prior to re-cropping or pasture;*
- *better sheep use of paddocks after baling;*
- *stimulation of better weed and pasture germination after raking;*
- *improved chemical spray contact with soil after baling; and*
- *more efficient tillage for re-cropping after baling.*

3.11 We believe the proponents are disturbing, taking and using a minimum amount of the natural resources of the region as a whole (straw) and the area associated with pulp/paper mill site (i.e. land area, natural vegetation, air space and water).

3.12 Whilst straw removal will also entail some nutrient removal, it is generally acknowledged that WA soils are infertile by world standards and any cropping programme necessitates the introduction of fertiliser.

No response required.

b) Waste Paper Availability

3.2 Given the existing users and other proposed users of waste paper within WA, on what basis can the Moora mill be confident that it will be able to obtain the 50,000 tonnes of waste paper each year over the life of the project. Waste paper has a finite availability in WA and the competition for it is rapidly increasing. What happens if it is unable to gain the full level required.

The Proponent has properly researched the availability of waste paper as described within Section 4.7 of the PER document. We remain comfortable with the market supply of waste paper to the Moora mill.

c) Organic Carbon Removal

3.7 Removal of cereal straw from crop paddocks will impair soil fertility by lowering the organic carbon content of soils. Organic carbon is a necessary component of soil to help hold vital nutrient in a form available to plants.

3.10 The harvesting of straw is not in the best interest of maintaining a fertile soil, as it removes from the already impoverished soils of WA much needed nutrients.

The issue of straw removal and impact on soil fertility is dealt with in Section 7.3 of the PER document.

d) Straw Harvest

3.13 The procedure to estimate the size of the straw resource outlined in PER Appendix D5.2 appears capable of being adapted to account for the different productivity, and perhaps availability of straw, from different soils. Indeed, it should include this type of information when being used to estimate the quantity of straw available for harvest.

3.14 Harvesting methods that cut and bale straw (without raking) are to be preferred. As well the elimination of grazing after harvest and the adoption of minimum disturbance crop establishment practices are also preferred. These management options minimise the disturbance of surface soil and hence its erodibility. The Department of Agriculture and Land Conservation District Committee have a responsibility to encourage farmers to apply these sorts of management practices. However, in doing so they would look to the proponent to co-operate and support their effort. One way the proponent could do this would be to encourage the use of forage harvesters, in preference to mowing, raking and baling the straw.

The Proponent is confident that there are adequate straw resources available within the stipulated radius from Moora. However, the comments made regarding quantification of the resource availability are noted and will be taken into account during further project development.

Clearly the maintenance of farm viability from both the soil preservation and the financial points of view is critical to the ongoing availability of straw to the mill and therefore to the future viability of the project. It is therefore very much in the interests of the Proponent to maintain a close liaison with the Department of Agriculture and the farming community with respect to potential straw harvesting impacts. This is the intention of the Proponent.

e) Nutrient Depletion

3.15 Mention of phosphorous, nitrogen and potassium depletions (0.9 kg/t, 6.0 kg/t and 13.0 kg/t) resulting from removal of the straw and the replacement costs (P=$1.00/t straw, P & K=$7.63/t straw, and P, K & N=$11.33/t straw) should be made available in the PER.

The issue of nutrient balance was raised in the PER (Refer Section 7.3 and Table 2). Note is taken of the comment but attention is also drawn to the notes given in the PER and by the Department of Agriculture regarding the replacement of nitrogen by use of legume crops and the availability of a potassium store in some soil types. It is therefore considered that the nutrient removal quantity and corresponding replacement costs represent a worst case and that suitable management initiatives can be taken to minimise the impacts and consequent costs of nutrient removal arising from straw harvesting.

4. TRANSPORT

a) Mode of Transport

4.1 Council believes that finished products should be transported to the sea port (whether Geraldton or Fremantle) by rail.

4.6 The levels of transport utilisation of roads in this area is low and any increase in the traffic due to this mill will be insignificant.

The Proponent will select the mode of transport of all materials into and out of the plant based on cost, efficiency and other economic factors. The PER demonstrates that adequate capacity is available via existing road or rail links to accept the additional freight generated by this proposal.

b) Transport Procedures

4.2 Council believes that the people or companies contracted to, or responsible for, the delivery of straw to the mill site should be required to ensure that baling and transport methods are such that a minimum of straw pieces are lost en-route to the mill - this is particularly important where a straw delivery route passes through a townsite, particularly Moora.

4.7 Transport of the caustic, condensate and ammonia will be undertaken on licensed dangerous goods vehicles by licensed drivers in compliance with the Department of Mines Regulations.

All transport operations will be carried out in accordance with well established procedures and government regulations. The Proponent will discuss straw transport routes with the appropriate Shire Council and relevant local authorities.

c) Rail Transport

4.3 Building the site adjacent to rail would enable the operation to be more efficient, due to materials being brought to site by rail, reduced manpower and reduced expenditure on road access.

4.4 Council believes that Westrail should provide a railway siding on the west side of the Midlands road to enable loading of the paper and pulp products onto rail without trucks crossing the road to the east side of the railway line. To load on the east side would mean a truck crossing the road approximately every 12 - 15 minutes during daylight. It is considered safer to have a protected rail crossing than many trucks crossing the road.

The Proponent recognises there is a section of the community which indicates a clear preference towards rail transport. The Proponent itself agrees with the broad community preference of using rail transport for product transport thereby better utilizing existing infrastructure. Road transport freight rates however, are significantly less expensive and therefore contribute towards the viability of the project. Not withstanding the competitive position of road freight, the Proponent has been and continues to actively explore with Westrail both the capital costs associated with establishing a rail line direct to the site as well as opportunities available for Westrail to decrease the freight rate.

d) Supportive Comment

4.5 The Geraldton Port Authority believes the project will have positive impact on the Port itself because of direct employment at the port, stability of the stevedoring workforce, and provision of revenue which will assist the operation, maintenance and development of port facilities.

No response required.

e) Road Transport

4.8 A more specific definition is required of the route to be used between the mill, Perth and Geraldton. The Department understands that the proposed route is Great Northern Highway and the Moora - Dongara Road then Brand Highway to Geraldton.

4.9 In terms of the transport requirements of raw materials and product, the MRD would give consideration to the approval of B-Double combinations between Fremantle and Geraldton along acceptable routes. The use of B-Doubles on local authority roads required for straw cartage will need to be assessed on a road by road basis. The agreement of the appropriate local authority would also need to be obtained.

4.10 The approval of the use of the B-Doubles would be subject to evaluation of the upgrading requirements of the routes and a satisfactory negotiation with the proponent of an arrangement for the sharing of the cost of work. The works which may need to be undertaken include:

- *construction of suitable intersections between the access roads to the mill site and the rail siding with the Moora-Dongara Road;*
- *installation of lighting at the above intersection if night time operation is required; and*
- *improvement of other intersections and railway crossings on local government roads that may be necessary for safe operation of the permitted vehicles.*

4.11 The MRD is also prepared to consider the use of road trains up to a maximum of 33 metres length between Upper Swan and the mill site, along Great Northern Highway and the Moora-Dongara Road, and between the mill and Geraldton along the Moora-Dongara Road and Brand Highway. It is likely that the use of road trains would only be permitted if additional passing lanes were constructed on the Moora-Dongara Road. The proponent would be required to contribute towards the cost of these passing lanes.

The Proponent has yet to finalize all transport arrangements required by the project. The matters raised above are noted and will be incorporated into the project planning and design process. The appropriate approvals will be sought during the project planning stage.

5. EFFLUENT AND OTHER EMISSIONS/WASTES

a) General Comment

5.1 Council places a high level of reliance on the EPA to set standards appropriate for the kind of project proposed by River House.

5.2 The proposals for groundwater extraction and groundwater monitoring are satisfactory.

No response required.

b) Deoxygenation of Groundwater

5.3 A portion of the organic loading within the washwater waste, should this reach groundwater or salt lakes, will likely be degradable by bacteria, which may lead to deoxygenation of groundwater, or surface water should migration of the soluble organic contaminants to this degree be possible. Deoxygenation may also lead to odour nuisance around groundwater seeps or in salt lakes under certain conditions.

It is correct to assume that a portion of the organic loading in the washwater waste will degrade and hence may reduce the oxygen content in the groundwater. However, the washwater will receive anaerobic and aerobic treatment to reduce biological oxygen demand but there will still be minor amounts of residual material (e.g. cellulose). The majority of this remaining biodegradable material is expected to be retained on the upper (aerobic) layer of the soil profile. Bacteria present in this layer of soil will break down the material and therefore minimise the amount of biodegradable material reaching the groundwater and therefore also minimising the risk of deoxygenation.

c) Groundwater Impacts

5.4 Adjoining land owners do not wish to have their plans to use and further develop their land prejudiced because of degradation due to the effluent irrigation.

5.5 After irrigation the effluent has no alternative but to spread out in the lines of least resistance, these being laterally west, north and east. Water could also go down to the Leederville Formation.

5.9 Approximately 50 per cent of the uncleared area adjacent to the site is suitable to develop for cropping and grazing operations - provided it is not first degraded with excess water, sodium carbonate and other toxic substances.

5.10 As the irrigation water will contain 4,800 mg/L TDS mainly sodium carbonate, soluble straw components and crop spray residues the result would be contamination of neighbour's domestic and stock water, contamination of soils adjoining land and killing a wildflower plantation and native vegetation.

5.18 The shallow waters near to site A are reasonably fresh-

1.5km SW	*236 mg/L*
1.5km W	*160 mg/L*
2.0km NW	*700 mg/L*

5.21 *It would be valuable because of the possible effect of elevated COD to know more about the potential impacts of wastewater irrigation on groundwater and the salt lake system.*

5.23 *Local experience has shown that the near surface of the site and its surroundings consist of random lateritic high areas with varying depths of sandy soils lower than and between the laterite. These sandy soils appear to be underlaid with an undulating impervious layer of laterite, clay and sandstone. Since clearing the basically freshwater has collected in basins of the impervious layer. These are the only waters available to neighbouring farms.*

5.27 *Sodium and colour contamination would affect farm activities with water being rendered unsuitable for domestic purposes as well as being unfit for stock.*

5.31 *The contours of the proposed irrigation site have a sandy ridge each side of a steep valley running down towards the mill site. Irrigation water would almost certainly seep towards the mill site and raise the water table above the current end of the summer depth of 2.5m.*

5.32 *The entire area around the mill site has groundwater suitable for livestock with selected pockets suitable for human consumption (p. 38).*

5.33 *The fact that the project will have minimal environmental impact, I believe the liquid effluent will be used to irrigate a tree plantation, has also contributed to the community's positive outlook.*

5.34 *The groundwater on the north east corner of Lot 2007 is 3,700 mg/L with a water level of 2.5m below ground level, even in early April.*

5.37 *Indications are that the soil in the area has a shallow clay horizon and good drainage of the area may not be possible.*

5.40 *The project must not have any detrimental effects on established users of the water resources downstream of the project's waste management and disposal facilities.*

5.42 *The proposed discharge of approximately 2,800 cubic metres of water will add to an already rising water table which is approximately 4.5m at the mill site.*

5.43 *The sands are not very deep in this area and waterlogging in the root zone of the proposed tree plantation may occur. This may become an important issue with 3,800m^3/day of highly saline, treated effluent disposed per day.*

5.53 *There is room for concern that the existing groundwater, stream and land resources would suffer degradation. It is possible that the spread of a plume of highly saline leachate in the groundwater would degrade existing high quality groundwater resources in the Leederville Formation, west of the Darling Scarp, and/or cause the outbreak of saline seeps, in the vicinity of the proposed site and towards the Coonderoo River.*

5.54 *The PER suggests that the saline leachate would seep eastwards to the Coonderoo River. However, surface slope and relief in the vicinity of the proposed site indicate a fall to the east, north and west. Such saline accessions to the local perched water table (see attached figure) would probably result in both on-site and off-site saline seeps and, possibly, degradation of the nearby native wildflower plantation if they were to move in any of these directions. Our data show the water table had a summer/autumn, seasonal high salt content of 4,345 mg/L on 18 March 1991. During winter, when water table would rise, this salt content would normally be considerably less.*

5.55 *In addition to the extra site investigations proposed in the PER, further exploration of effluent disposal options is clearly required. On such option could be perimeter drainage of the saline leachate from the timber plantation and the piping of this excess effluent to the Coonderoo River.*

All available information regarding local groundwater conditions and soil profiles at and surrounding the site have been presented in the PER. It is agreed that the site has not been the subject of detailed investigations and this is reflected in the commitments given in Section 9 of the PER.

It is recognised that salts in the washwater stream will reach and enter the groundwater. This is expected to result in a plume of more highly saline water beneath the site and, as far as can be determined by assessment to date, moving towards the Coonderoo River. Conclusions drawn regarding flow of groundwater towards the Coonderoo River are based on interpretations of landform, distances and regional geology and geomorphology.

The veracity of these conclusions will need to be confirmed during detailed mill design as referenced in the commitments given in the PER (Section 9).

It is likely that the underlying clays will not be sufficiently permeable to conduct the additional flux of water averaging about 1.3mm/d (irrigation rate averaging 2.6mm/d and leaching fraction 50%). The overlying sands (about 2.5m deep where drilled) are highly permeable and would be easily drained by ditches, buried slotted pipes, or shallow well-points.

The extent and degree of unacceptable salinity increases on neighbouring properties cannot be defined at this stage. A comprehensive monitoring programme is proposed and committed to as well as the formulation of contingency plans designed to ameliorate any adverse impacts on neighbouring properties resulting from wastewater disposal from the mill.

In commitment 3 of the PER (refer Section 9) the Proponent has undertaken to prepare a contingency plan designed to ameliorate adverse shallow groundwater impacts should they occur. The details of such a contingency plan will depend upon the findings of detailed hydrological studies undertaken for the project in relation to washwater disposal. The studies will identify:

- the detailed shape and direction of flow of the current superficial aquifer;
- the potential rise in groundwater levels due to washwater application;
- changes to flow directions of groundwater due to the mounding effect of washwater application;
- the expected shape and movement of the saline and coloured water plume away from the site;
- any potential areas where the altered water table may intersect ground surface leading to seeps and salt scalds.

These theoretical analyses and predictions will be checked during operations by the proposed monitoring programme. If it is found that seeps and scalds develop action will be taken to install shallow drains, slotted agricultural pipes or even dewatering spears to alleviate the problem. Investigations to date confirm that the natural surface soils of the site area are amenable to such groundwater drainage techniques.

During discussions on 7 May 1991, between the Proponent and neighbours, the suggestion was made for the Proponent to directly discharge into the Coonderoo River any additional water which accumulates and causes the water table to occasionally rise locally as a result of the combined effect of irrigant disposal and wet weather. Direct discharge to the Coonderoo River could be via open, clay based, channel or enclosed pipeline.

When wet weather occurs, any direct disposal into the Coonderoo River will be flushed by the effects of rainwaters flowing in the river. The Proponent believes that such action would not adversely impact on the existing water quality in the Coonderoo River. This is considered to be a viable option by the Proponent and will be further investigated in the detailed design of the project.

A contingency plan will be formulated such that all available alternatives for remedial action will be included for consideration.

Decisions on the most appropriate remedy will be made, if and when the need arises, on the basis of the problem, its cause and the most cost effective remedial option available. The Proponent will seek advice in accordance with commitment 3 of the PER (refer Section 9).

d) Salinity

5.6 Although the contribution of TDS from the project is high in relation to the area of the site compared to the Moora River catchment as a whole (specific yield 112 kg/ha/day for the site vs 0.8 kg/ha/day for the catchment), the total annual salt yield from the project site is only 0.9% of the annual salt load at the Quinn's Ford gauging station.

5.7 Any saline addition to the water table is not acceptable.

5.8 Section 4.9.2 The need to supplement irrigation water from the wastewater stream with fresh water from the water supply has not been considered. This situation may arise if the quantity of wastewater is insufficient to meet the water demand of the plantation or if evaporation and evapotranspiration rates exceed the theoretical values suggested, increasing the TDS level of the remaining wastewater entering the groundwater and inadequate flushing of salts through the soil.

5.11 As the project has a proposed life of at least 20 years the total loading of contaminants that will be discharged to the soil and groundwater system will be substantial.

5.36 There is a high risk of excessive mounding of the groundwater and salt in the irrigation area. This may cause the land to become unusable for agriculture and result in tree deaths.

5.46 The use of the data from the Moora River gauging station at Quinn's Ford may be dubious given that it is a mainstream gauging station, and in addition is located some 40km downstream of the project site. Although the WAWA has no information on the salinity of the Coonderoo River, it is suspected from local observations that the salinity of the Coonderoo is likely to be somewhat higher than the Moora River, and therefore the impact of the saline wastewater contribution may be minimal.

5.47 The use of wastewater to irrigate trees and the residual deposition of excess wastewater to the Moore River does not in our view pose any risk of increased salinity in the area.

5.49 We are concerned that saline effluent disposal may have an adverse impact on the environment. We would recommend the local Land Conservation District Committee and the Department of Agriculture be consulted on this issue. The situation should be strictly monitored and if found to be adversely affecting the environment, whether locally or downstream, the Proponent will need to find another method of disposal.

5.50 What effect will the increased saline groundwater have on native flora species, especially that in Banksia heath, especially should the groundwater level rise through mounding under the irrigation area.

The presence of shallow groundwater confirms the observation of moist sand at 2m depth in a swale on the property (Appendix C, p. 6). The salinity of the shallow water as addressed by the respondents confirms the opinion expressed for this area (Appendix C, p. 3, Site A) that there is likely to be some fresh groundwater at shallow depth probably underlain by brackish or saline groundwater.

The Proponent has committed to a detailed and comprehensive monitoring programme related to groundwater impacts and particularly salinity impacts (refer Section 9 of the PER). Experience elsewhere indicates that the site meets criteria generally considered acceptable for such a wastewater disposal practice as detailed in Section 4.9.2 (d).

Only washwater will be used for irrigation to minimise the quantity of water reaching the underlying aquifers. On average the trees will receive a total of rainfall plus irrigation amounting to about 63% of tank evaporation. Salts will accumulate in the surface soil during summer, to reach a salinity of about 0.2% in the top metre. The salts will be leached downwards by rainfall and irrigation in winter.

WAWA gauging station data relating to existing salt loadings within the Moore River catchment collected during preparation of the PER demonstrates that the mill effluent will not add significantly to the salt loadings on the Coonderoo and Moore River systems.

As previously mentioned, contingency plans will also be formulated to ameliorate any adverse impacts on neighbouring properties if the need arises.

e) Plantation System

5.12 Comment should be provided regarding the level of confidence that is placed in the ability to acceptably manage wastewater by a spray irrigation scheme using river gum plantations.

5.16 It is strongly recommended that trials be conducted with E camaldulensis in pots watered with "synthetic wastewater" to determine their ability to survive the project irrigation regime.

5.38 Experience in the use of saline water for irrigation in other parts of Australia and overseas has shown that sustained tree health is only possible if sites have good vertical drainage and a high depth to water table. The paper mill site appears to have neither. The Proponent may need to install a backup system to pump the wastewater to the Coonderoo or Moore River in the event that irrigation is not successful.

5.41 The proposal to plant trees to use the waste water is not satisfactory as trees use very little water for some years.

5.48 The waste water has the ability to support a valuable agro-forestry industry with combinations of trees and hardy fodder shrubs on very poor soils. This in fact could be a model for much larger agro-forestry developments in the district.

The Proponent has evaluated the suitability of the site for plantation irrigation effluent disposal against criteria developed from experience on other applications elsewhere in Australia and overseas. Details of this evaluation are given in the PER in Section 4.9.2 (d). The PER also contains a number of commitments (Section 9) referring specifically to the detailed design of the plantation system that will proceed in the detailed design stage.

Further, the 210ha site (Lot 2007) provides scope to increase the nominal 110ha of plantation area if this is required as a refinement of preliminary predictions. The Proponent recognises the potential benefits of operational trials after plant start up involving finally selected salt-tolerant species. The Proponent reconfirms commitment 4 Section 9 of the PER.

f) Chemical Contamination

5.13 Harvesting of straw from crops that have been sprayed with a wide range of agricultural chemicals will certainly bring harmful chemicals to the mill. Further, whilst these chemicals will be in minute amounts at the site of application, to bring chemical residues from 100,000ha and apply to 150ha could cause havoc to wherever the water seeps.

5.17 It is thought that the majority of agricultural chemicals presently used have short half-lives in the environment and therefore it could be that pesticide/herbicide residue levels in the straw are actually very low.

5.20 It would be desirable to know whether there is any possibility of heavy metal accumulations in either the soil or shallow groundwater within the irrigation area that could possibly limit alternative uses for the site following decommissioning of the plant.

5.26 Separate chemical analysis of the black liquor and wash water presented in the PER are not comprehensive. A complete list of effluent composition, including heavy metals, pesticides, herbicides and hydrocarbons, should be listed to provide prior to any approvals being given.

5.29 The chemical analytical data that is presented for the black liquor and wash water waste streams is quite limited. It would be of interest to know the composition of these wastes with particular regard to trace and heavy metals, and possibly pesticide and herbicide concentrations.

It is not considered that there are significant residual amounts of agricultural chemicals in wheat or wheat straw. Indeed, Australian wheat is strongly marketed around the world on the basis that it is chemically untainted (personal comm. Australian Wheat Board). If, however, trace quantities of agricultural chemicals are introduced into the process the majority is expected to be removed in the straw digestion process and thereby be removed by the black liquor. Very little if any of these traces of agricultural chemicals are expected to be present in the washwater waste.

Heavy metal accumulation in the soil should not be a problem. As detailed in the PER sources of heavy metals are likely to be printing inks. However, modern inks do not contain high concentrations of heavy metals due to health and safety considerations.

Further, the majority of ink removal will occur in the repulping stage of the process with waste sludges (ink, fillers, etc) from this point being directed to the incinerator. It is therefore not anticipated that high concentrations of heavy metals or accumulation of such materials will occur as a result of washwater disposal. The disposal of incinerator ash is addressed in Section 5 (u).

g) Alkalosis

5.14 Increased ingestion of sodium leads to the imbalance of electrolytes which gives rise to a condition known as alkalosis. Marked alkalosis may be accompanied by the syndrome of tetany. Death follows. Thus all stock including native fauna would be affected.

The phenomenon of alkalosis is well documented and may result from an excessive ingestion of sodium. Tetany is a response to alkalosis and is marked by the onset of trembling and fits in the animal. Alkalosis will result from continuing ingestion of high salinity waters. Since the area of the mill and the plantation area is not to be used for grazing this will not be a problem. Similarly, monitoring on adjacent properties will ensure groundwater is not adversely affected or that appropriate remedial action can be taken to prevent ingestion by stock.

The occurrence of high salinities in the vicinity of the Coonderoo River and the associated salt lakes suggests that there is a very low risk of alkalosis developing as a result of this project.

h) Downstream Ecological Impacts

5.15 Insufficient data is given from which to assess whether "downstream" environmental maintenance is an important ecological role of groundwater that passes beneath the proposed site.

5.51 While the salt lakes may be considered to be of little agricultural value because of poor, saline waters and soils, the PER does not provide data from which to evaluate whether this area has ecological values that are worth of consideration within environmental management planning.

As described in the PER and as outlined in these responses it is not anticipated that excessive salt loadings, colouration or other water quality impacts will occur on the Coonderoo or Moore Rivers. The only known examples of ecological systems associated with groundwater discharge in the area are saline seepages and scalds. These are by no means unique and their ecological value has no known recognition. An extensive monitoring programme is proposed and committed to by the Proponent to ensure that any impacts can be identified as soon as possible. There is also a commitment to formulate contingency planning to ensure adverse impacts are ameliorated satisfactorily (refer Section 9 of the PER).

i) Hydrology

5.19 The detail of the hydrology of the area presented on p. 46 of the PER has grossly distorted and changed the meaning of Appendix C p. 2 and 3, from which it is said to have been derived.

The description given in Section 5.4.1 (b) of the PER is considered to adequately reflect the contents of Appendix C as they apply to the hydrogeology of the site area.

The salinity of the groundwater is said to be about 7,000ppm which is not an accurate summary of p. 3 of Appendix C ("stock quality water up to say 7,000 mg/L total salinity is obtained from bores..."). This is an oversight in the interpretation of the hydrological report. However, testing carried out to date by the Proponent and the Department of Agriculture indicate shallow groundwater salinities in the range of 3,700 mg/L to 4,350 mg/L indicating the possibility of higher salinities at depth in the aquifer.

j) Existing Vegetation

5.22 Land to the west and north of the proposed irrigation area is uncleared virgin scrub, not containing some remnant vegetation as stated in the PER.

The PER deals with Lot 2007 and does not refer to surrounding properties with respect to existing vegetation. The observation is noted.

k) Discolouration

5.24 Section 7.4.2 If monitoring indicates that the Coonderoo River may be discoloured beyond ambient background quality, the Proponent may be required to recover and treat wastewater or groundwater to acceptable criteria. No details of alternative treatment methods to remove colour have been provided.

5.30 The colour of the irrigation water (1,000 platinum/cobalt units) is unacceptably high by world standards. It is environmentally unreasonable and inconsiderate to intentionally add this level of colour in the hope of filtering it out through surrounding sand. The White Paper "Pulp and Paper Industry Package" refers to a maximum of 20 platinum/cobalt units in Attachment A, p.20.

5.35 The potential impact of highly coloured, saline waters on neighbours around the plant is sure to be an ongoing management problem.

Reported experience elsewhere indicates that soil filtration has the capacity to effectively remove a large percentage of the colour loading of the wastewater. Further it can be anticipated that dilution of remaining colour will occur as water reaching the water table mixes with groundwater before reaching the Coonderoo River. However, it should be noted that water colour is an objectionable property in domestic water supply but it is not generally considered to be a serious problem for stock or aquatic life.

The commitment to establish a comprehensive monitoring programme (refer Section 9 of the PER) is designed to ensure adequate colour removal is achieved and that downstream adverse impacts do not occur.

If it is found that natural processes do not achieve an acceptable level of discolouration removal, the alternative treatment process of high lime application is available for consideration.

l) Treatment Efficiencies

5.25 Expectations of a 98% reduction in the organic load from the wastewater effluent stream may be optimistic based on the technology proposed.

The proposed treatment processes are based on well established technologies that have been shown elsewhere to be capable of achieving the specified results. In the case of the straw pulp and paper mill effluent flow rates and qualities will be comparatively uniform thereby facilitating control and management of the biological systems. Highly variable flow rates and effluent qualities are known to cause problems but this situation is not anticipated to occur at the mill.

m) Chemical Oxygen Demand (COD) of Washwater

5.28 The chemical analysis data provided on the wastewater stream is not particularly detailed. In particular, the COD of washwater prior to irrigation but following anaerobic treatment is not specified.

The COD of the washwater effluent after anaerobic and aerobic treatment is predicted to be approximately 750mg/L (for a corresponding biological oxygen demand of 150mg/L). Hence, it will be essential to apply effluent to the land quickly to avoid odour problems. Some effluent storage will be necessary to provide buffering capacity of flows and this will be in the form of shallow ponds or aerated deeper ponds to ensure adequate oxygen levels in the water to prevent odour generation. The detail design of this storage will be undertaken during the project engineering stage.

n) Deep Aquifer Contamination

5.39 The potential of wastewater leakage to contaminate the major aquifers in the Perth Basin to the west of the site has not been addressed. While it appears that significant contamination is unlikely, advice from GSWA should be sought to confirm this.

5.44 The site lies immediately over the upper tip of the Darling Fault as shown by Curtin University seismic and gravity exploration (see Young R.A., Stewart S.C., Seman M.R. and Evans B.J., "Fault plane reflection processing and 3D display: the Darling Fault, Western Australia, Tectonophysics, 173 (1990) 107 - 117).

5.45 Work done by Curtin University in 1985 and 1987 has established the surface position of the Darling Fault to be 4.15km east of Price's Road, i.e. just east of Location 2007. There is a considerable fault zone, with many minor faults both vertical and oblique showing in the underlying strata. These are areas which could allow seepage to enter into the Leederville Formation, according to Curtin University's Exploration Geophysics Department.

The GSWA advise that it is suspected that there would be no westward flow of groundwater from the site in the Leederville Formation, but this would have to be confirmed by detailed levelling. The geology and hydrogeology in close proximity to the Darling Fault is extremely complex but there is evidence to show that water in the Leederville Formation in areas north of the site flows east to the salt lake chain (the Coonderoo River).

GSWA expect that groundwater in the superficial sands will move eastwards from the site to the Coonderoo River.

o) Alternative Disposal Methods

5.52 Whilst there would appear to be a high chance of success with the irrigation approach, based on experience, it would be valuable to understand the options that are available to the project in the event that waste water management performance is poor, for example in terms of plantation viability, soil clogging, groundwater quality or potential impact to the nearby salt lakes.

A number of alternatives are available to treat and dispose of the waste water from the mill. The option detailed in the PER represents, in the opinion of the Proponent, the most acceptable method at this stage. The Proponent reconfirms commitment 4, Section 9 in PER.

p) Atmospheric Emissions

5.53 Air emissions are likely to include at least two environmentally troublesome components - SO_2 and particulate sodium carbonate. Scrubbing could remove both and the sodium carbonate could be physically separated. The levels of SO_2 (mainly from high sulphur crude oil) are not high compared with, for example, roasters in the gold mining industry.

5.54 For the black liquor waste, it would be desirable to know whether incineration could produce undesirable chemical species in the exit gas, as a result of the presence and concentration of pesticide or herbicide residues in the effluent.

5.55 It would be desirable to have more data regarding the composition and physico-chemical characteristics of the black liquor incinerator exit gases. The potential for this waste gas to create a visible plume, and the size, persistence and local visibility of any plume that may be formed would be desirable to know.

As detailed in Sections 7.7 and 8.7 of the PER preliminary evaluations of exit gases from the incinerator indicate that there will not be a problem in this regard. Mention is also made of the intention to install suitable filtering equipment on the stack if this is found to be necessary.

The Proponent is committed to meeting flue gas emission standards that are well established and accepted by industry generally. These standards are set such that no risks are posed to workers on the site or to neighbours of the plant. Detailed design will require accurate modelling of dispersion plumes under various atmospheric conditions to ensure the standards are complied with.

q) Odour Mitigation

5.56 Some consideration of the need for odour mitigation with irrigation is recommended.

There is likely to be a low intensity odour impact generated by the disposal of washwater effluent. Experience elsewhere indicates that this will be no worse than many agricultural activities. The separation distances between the proposed site and the nearest residence will provide a buffer zone to accommodate the odour impact.

r) Noise Levels

5.57 The noise levels predicted for the nearest neighbours to the plant are considered to be lower than would be expected. The typical noise level at 3,000 metres would be expected to be approximately 30 dbA rather than the 20 dbA quoted in Table 4 of the PER. In addition, the appropriate noise level for the site is considered to be category A2.

The noise levels quoted in Table A have been derived from computer model analyses and are "typical", not maximum levels. The Category of B1 has been referred to because of the site characteristics quoted in Section 7.9.2 of the PER.

s) Kiln

5.58 What is the temperature and at what residence time will the rotary kiln be run? What will be the designed maximum throughout of the kiln at the nominated temperature and residence time? Will the kiln be run continuously or as batch. What is the fate of chloride ions in the black liquor disposed of in the kiln?

The detailed design parameters of the kiln have not been determined at this stage of the project. The process does not consume chlorine. This is a specific advantage when compared to wood pulp and paper mills.

We believe from industry sources that peroxide is used by Australian industry to whiten newsprint. Accordingly, trace quantities of chloride ions will not be introduced via the introduction of waste newsprint to the process.

t) Figure 8

5.59 Figure 8, showing nearest residences, could not be located in the PER.

The omission of Figure 8 from the PER was an error and it is included as an attachment to this response.

u) Sodium Carbonate Ash

5.60 High technology filtering processes should be investigated aiming at reducing all effluent to a dry state and returning the dry waste, mainly sodium carbonate, to straw collection areas for application.

5.61 If significant quantities of sodium carbonate (up to about 11 tpd) in the incinerator are recycled this ash disposal will become less of a problem. The recycling option is obviously attractive on environmental grounds and hopefully the economies will also be favourable.

5.62 Sodium carbonate has a solubility of about 7% in fresh cold water and therefore has the potential to produce leachate with high TDS under the influence of percolating rainfall or groundwater. In view of the relatively large quantities of this waste that will be produced (about 5,000 t/annum or about 7,500 m3/annum, or about 100,000t over the project life) it is considered necessary to understand how a disposal site will be designed and operated, and the site options that have been identified.

5.63 The deposition of solid wastes into Council's landfill sites, if alternatives cannot be implemented, would be against Shire of Moora regulations with regard to chemicals disposal.

5.67 The alternative idea of the sodium carbonate waste having some value as an amendment for acid soils requires investigation before it is promoted. In terms of neutralising value, it is roughly equivalent to calcium carbonate. However, the high percentage of sodium would induce undesirable dispersion of the clay fraction of soils. This would predispose the soils on which is was applied to waterlogging and/or runoff and erosion.

The recycling and sale of sodium carbonate ash is an option available to the Proponent and was discussed at the public meeting in Moora. The Proponent will make every attempt to achieve economic use of the ash. In particular sodium carbonate can be used for glass manufacture, producing a wide range of chemicals, soaps, detergents and for water treatment addition. Further, we note the opportunity for the rural community to purchase the sodium carbonate for pH soil correction.

As detailed in the PER (Section 9) there is a commitment to identify a suitable solid waste disposal site to service the mill and the restrictions on use of the Shire of Moora landfill sites is noted. It is, however anticipated that a suitable site will be found in the vicinity of the mill where leachate generation can be minimised and the potential for water contamination can also be minimised.

6. MONITORING

a) Monitoring Programme Details

6.1 Monitoring of groundwater levels and salinity with regular reporting to the WAWA will be an essential requirement for this plant.

6.3 The monitoring programme outlined in the PER will be adequate to assess the Leederville aquifer performance. It is important that a regular monitoring programme is carried out to assess the aquifer response. Further, it is necessary to know exactly which wells are to be included in the programme.

6.4 The Proponent should monitor any stock watering or domestic bores in the plant area for changes in salinity levels.

6.5 While the proposed monitoring programme to assess the aquifer response to the irrigation is adequate, further details are required on the positioning of the monitoring bores for the programme.

The detailed planning and design of the various monitoring programmes outlined in the PER (Sections 8 and 9) will be undertaken as part of the overall mill design phase. Approvals to these proposals will be needed before implementation by the Proponent.

b) Alternative Disposal Methods

6.2 The proposed Groundwater Monitoring (Section 8.3) for a period of at least 12 months prior to commencement of the mill is commendable, however if adverse conditions for the proposed method of waste water disposal are found to exist, a commitment must be provided by the Proponent to institute an alternative approved waste water disposal method.

This issue has been addressed in 5(o) above.

7. OTHER ISSUES

a) Commitment Format

7.1 Many of the commitments in the PER do not address the requirements layed out in the EPA guidelines as to (a) who, (b) what, (c) when, and (d) to whose satisfaction.

The Proponent believes that each commitment is framed in such a way as to meet the above requirements either explicitly or, in some cases, implicitly.

b) Public Participation

7.2 Public participation has been mainly promotional and any hazards have not been publicised.

The public participation and consultation programme has presented to the community at large a full and factual account of the proposal on all occasions. As detailed in Sections 1.1, 2.2 and 3.4 of the PER the technology chosen for this project is chemically mild and is not environmentally dangerous. These factors were taken into account in selecting the mill site.

c) Commitments

7.3 The WAWA is satisfied with the commitments given in Section 9.

7.5 The commitments listed by the Proponent in Section 9 of the PER seem generally adequate to ensure compliance with relevant statutes and environmental management principles.

No response required.

d) Section 1.6

7.4 Section 1.6 The relevant legislation also includes the "Rights in Water and Irrigation Act".

7.13 Section 1.6 should also include the Main Roads Act as this allows the Commissioner of Main Roads to control the vehicle combinations permitted to use highways and main roads under this control.

The Proponent notes these omissions and will include compliance with the nominated legislation.

e) Wheat Rust

7.6 The irrigation area will provide an ideal environment for wheat plants to grow over summer. Over summer wheat and some grass plants are ideal to carry wheat rust organisms, thus starting a rust epidemic in the following season.

Refer to the response to 7 (i) below.

f) Vermin

7.7 A tree plantation would provide an ideal habitat for foxes and rabbits, both of which are troublesome to farmers.

The Proponent will formulate and implement a vermin control programme. This will be included as part of commitment 4, Section 9 in PER.

g) Racial Tensions

7.8 Racial tensions could be rather daunting for women at home on their own and would need to be discussed before bringing families to the area.

Moora is a well-established, stable community and there is, to the knowledge of the Proponent, no evidence of the situation portrayed above.

h) Approvals

7.9 The correct procedures in regard to the regulations of the Aboriginal Heritage Act 1972 should be met.

7.10 The proposal for rezoning of the subject land will be asked by DPUD in accordance with its Policy (No. DC4.1) "Industrial Subdivision" and draft policy on "Planning for Hazards and Safety". The subject land is considered to fall most closely within the "Noxious and Hazardous Industry" zone within the Shire of Moora's District Scheme - Town Planning Scheme No. 3.

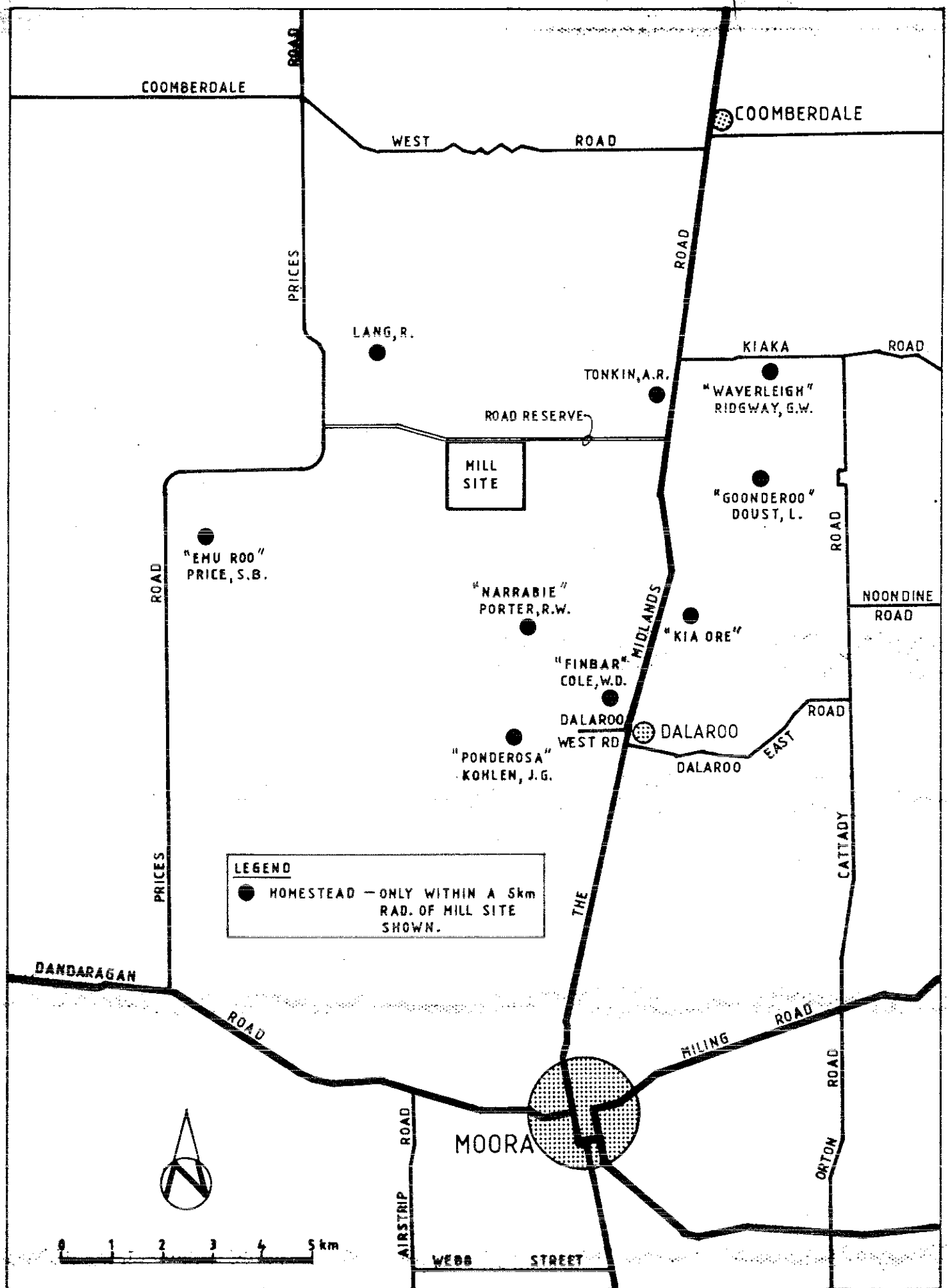
The Proponent is aware of these issues and requirements and will progress the project accordingly.

i) Ryegrass Toxicity

7.11 The proposal is unlikely to lead to any risk of increased spread of rye grass toxicity.

7.12 Transporting of straw containing ryegrass toxicity will spread the disease to another area much quicker. The same applies to other weeds, including skeleton weed.

The subject of ryegrass toxicity is discussed at some length in Section 7.11 of the PER. The spread of other weeds is a risk of the project but there is no evidence to suggest that the project will significantly increase existing risks in this regard.



NEARBY RESIDENCES TO THE SITE

Figure 8

List of people and organisations making a submission on the Public Environmental Review to the Environmental Protection Authority

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Department of Mines

Hon J Brown, M.L.C.

Mr W J McNee, M.L.A.

E Cook

Mr R Lang

Mrs A Lang

Mr A Tonkin

Regional Manager
Central Region

Mr J N Warne
Shire Clerk

A/Co-ordinator
Country Division

Executive Officer

Executive Director

Hon M McAleer, M.L.C.

Mr M Trenorden, M.L.A.

General Manager

Ms R Siewert
Co-ordinator

Marketing Director

Mr I Hannah
General Manager

Director

Commissioner of Main Roads

Deputy Director General of Agriculture

Mr W Cohen
Director

Member of the Agricultural Region

Member for Moore

Dandaragan WA 6507

Moora WA 6510

Moora WA 6510

Coomberdale WA 6512

Water Authority of WA

Shire of Moora

Department of Planning And Urban Development

Wheatbelt Aboriginal Corporation
Northam WA 6401

The Western Australian Farmers Federation (Inc)

Member for the Agricultural Region

Member for Avon

Geraldton Port Authority

Conservation Council of WA

Fremantle Port Authority

The Hay Machine
Koorda WA 6475

Geraldton Mid-West Development Authority

WestPaper Pty Ltd
Perth WA 6849

Appendix 3

Further information provided by the Proponent in relation to potential effluent disposal impacts

11 June 1991

The Chairman
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

Attention: Colin Murray

MOORA PULP AND PAPER COMPANY PTY LTD
part of THE RIVER HOUSE GROUP
A.C.N. 009 464 037

Ground Floor, 16 Ord Street, West Perth WA Australia 6005
Phone: 61+9+322-3922, Fax: 61+9+324-1845

Dear Sir

Moora Straw Pulp and Paper Mill
Response to Query

We write further to a meeting between Messrs C Murray and F Murray on 4 June 1991 and a meeting between Messrs C Murray, F Murray and A Peck on 7 June 1991.

The EPA has asked the Proponent to outline its basis for management strategies with regard to

(a) Dieback control
(b) Waterlogging and salinity
(c) Groundwater contamination
(d) Groundwater monitoring

(a) Dieback control

Dieback disease (caused by various species of Phytophthera) can spread in banksia trees growing on Bassendean Sands. It has been claimed that dieback could become a problem near the site of the Moora mill.

According to CALM, Phytophthera is unlikely to survive in stacks of straw, because antagonistic organisms are found around normal hay stacks.

Infected soil is considered to be the most likely means of introducing Phytophthera to the site. Straw trucks will come into the site on sealed, well-drained roads, and off-load on a sealed, well-drained area. It will be important to avoid a muddy environment where trucks could pick up infected soil. If this is achieved, then vehicle wash-down will not be necessary. Runoff from the sealed delivery and storage area could be collected in a suitable sump, and pumped to the process circuit in place of fresh water.

The dieback fungus will not survive a pulping process involving temperatures of about 90^0C or more. From this stage, both the product and the water stream will be sterile unless exposed to infected soil or straw. The plant will be designed and managed to keep any possibly contaminated material clear of the waste water stream.

(b) Water-Logging and Salinity

It is inevitable that disposal of waste water will cause some increase of groundwater levels beneath the site and nearby areas, particularly those in the direction of groundwater flow. It has been claimed that increasing water levels could cause water-logging and salinity of surface soils in low-lying land. The following actions are recognised by the Proponent as methods which will prevent excessive increases of water level.

- Monitoring bores will be placed in the shallow aquifer at intervals of about 200m around the lower boundary of the site, and water levels and salinities recorded regularly.

- Depending on an analysis of the original (pre-irrigation) water levels, criteria for acceptable changes will be established in consultation with WAWA and the EPA. If water levels increase beyond the acceptable level, then the Proponent will install drains to control water levels in the critical areas (probably along the boundaries of the lower-lying, north-east corner of the site). Either ditch drains, slotted plastic drains, or a line of spears are options available to the Proponent.

- Water from the drains will be directed to the process circuit where it will replace part of the fresh water input, or it may be pumped to the Coonderoo River when it is flowing.

- Monitoring bores will be installed in off-site, but nearby areas where there is a possibility that water-logging and salinity could develop. Monitoring bores will be chosen in discussions with adjacent landowners or their representatives. These sites will most likely be within 1km of the area of waste water disposal.

- The Proponent is prepared to enter into a commitment to prevent the water level in these areas rising beyond a critical level, as a result of waste water disposal. The extent of acceptable change should be agreed beforehand with WAWA and EPA. The most appropriate method for groundwater level control will depend on the particular situation, and any reclamation work will be undertaken with the agreement of WAWA, the EPA and the owner of the land.

- The Proponent recognises it may find a need to control water-logging and salinity by installing some form of drainage in lower lying parts of its own property.

(c) Groundwater Contamination

It is predicted that a plume of slightly more saline water will develop from the irrigation area. Installation of drains would limit, but not entirely prevent the growth of this plume. The plume will probably extend eastwards from the site towards the Coonderoo River, but it has been suggested that there may be some flow to the north-west, affecting a private bore used for domestic and stock water supply.

With the owner's permission, the water level and salinity of the private bore will be monitored. If there are significant changes which can be attributed to the pulp mill, then the Proponent undertakes to provide an alternative supply or supplies. It is likely that the groundwater will remain suitable at least for stock usage. If necessary, an alternative domestic supply will be decided in consultation with WAWA and the land owner.

(d) Groundwater Monitoring and Commitments

The groundwater monitoring which is recommended above, is adequately covered by Commitments in the PER. Additional commitments provided in this letter are:

- sealed roads to be constructed at site for straw delivery;

- straw delivery area to be drained to sump, and runoff added to process stream;

- design and management of plant to prevent contamination of wastewater stream by any Phytophthera from straw delivery area;

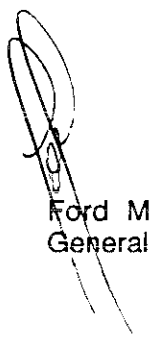
- liaison with WAWA and EPA to develop criteria for acceptable changes of water level in monitoring bores around the perimeter of the site and on neighbouring properties;

- install a drainage system around the perimeter of the site if water levels in monitoring bores increase beyond the agreed maximum as a result of effluent disposal from the plant;

- undertake actions to lower groundwater levels in off-site areas if monitoring bores show that the water levels have increased above the agreed maximum as a result of effluent disposal from the plant;

- provide an alternative domestic supply if monitoring shows that the water quality at a neighbouring farm falls below guidelines established by the NHMRC as a result of effluent disposal from the plant.

Yours faithfully



Ford Murray
General Manager

Appendix 4

Submission by the Department of Agriculture on the PER

STRAW PULP AND PAPER MILL, MOORA - DEPARTMENT OF AGRICULTURE RESPONSE FOR THE PUBLIC ENVIRONMENTAL REVIEW

INTRODUCTION

The Department of Agriculture is concerned with enhancing the productive capacity of the State's agricultural industries in ways that are consistent with the conservation of its land resources.

The Straw Pulp and Paper Mill proposal provides an opportunity for increasing farmer income and developing an alternative industry in Moora. However, issues that need to be addressed include the methods of harvesting straw and disposing of effluent and waste products as they may affect the local soil and land resources. This submission focusses on these areas.

STRAW HARVESTING

Straw is a natural companion of the production of grain. It is generally of low value as a feed and hence currently has little value to a farmer. It has traditionally been burnt but increasingly is being left on the surface to protect the soil. The pros and cons of straw removal are a debatable issue.

The removal of straw for pulp has several agronomic benefits. Copious quantities of straw make the preparatory work for the next crop difficult. The benefits that would accrue if the straw was removed for paper pulp include:

- obviating the need to employ alternative removal or avoidance methods, such as burning ; grazing and/or raking; or the purchase of special stubble handling machinery (which is an additional cost);

- easier and more efficient control of weeds (herbicide is able to reach the leaves of weeds in sufficient quantities to be effective);

- easier and cheaper crop seeding operations.

In addition, there is the other benefit of possible extra income from a resource which is of limited use and value to the farmer, i.e. that stubble which is in excess of the amount required to prevent wind and water erosion and provide feed for grazing stock.

There are however, disbenefits in removing straw. These include the impact such removal has on the likelihood of the soil being degraded by wind erosion and of succeeding lupin crops being subject to fungus diseases. Agronomically it is important to leave straw on the surface when a lupin crop follows wheat on sandy soils. This minimises the risk of fungal infection of lupin seedlings.

There are four areas of concern with straw harvesting that the PER does not adequately satisfy:

- straw collection from soils of varying suitability;
- harvesting straw;
- balancing the demand for straw pulp against seasonal variations in supplies and needs for land conservation;
- nutrient renewal

Soil Suitability

Soils vary in their productivity and erodibility. Generally, the more productive soils are less prone to wind and water erosion. Hence, from a land conservation viewpoint harvesting poses a lesser hazard on the Red Brown Earths (York Gum soils), Solonised Brown Soils (Salmon Gum soils) and Lateritic Podzolic soils with ironstone on the surface (Stoneman, 1990; draft Farmnote, attached).

The soils with sandy textured surfaces in the region are a high hazard for straw harvesting. They have lower productivity and a high wind erosion risk (i.e. need for stubble retention).

The procedure to estimate the size of the straw resource outlined in the PER Appendix D5.2 appears capable of being adapted to account for the different productivity, and perhaps availability of straw, from different soils. Indeed, it should include this type of information when being used to estimate the quantity of straw available for harvest.

Harvesting Conditions

For straw harvesting to be undertaken in a manner that minimises the likelihood of wind erosion, attention needs to be paid to the amount of stubble left, its anchorage to the soil and the amount of disturbance caused to the surface soil before and after such harvesting.

The Department's recommended levels of stubble to prevent wind erosion under normal farming conditions need to be increased for straw harvesting operations. Effectively the figures of 0.75 t/ha of standing stubble and 1.0 t/ha of standing and prostrate stubble should be doubled to 1.5 t/ha and 2.0 t/ha, respectively. These increases compensate for the shortness of the remaining stubble (about 10 cm) and the increased proportion of it that will be buried in in seedbed preparations for the next crop. (Normally about 50 percent of stubble is buried in seedbed preparation - see attached draft Farmnote.)

Stubble is most effective when it is anchored by its roots to the soil. Hence, the harvesting method and grazing management before and after harvesting are also important, particularly on sandy, wind erosion prone soils. Harvesting methods that cut

and bale straw (without raking) are to be preferred. As well, the elimination of grazing after harvest and the adoption of minimum disturbance crop establishment practices are also preferred. These management options minimise the disturbance of surface soil and hence reduce its erodibility.

The Department and Land Conservation District Committees have a responsibility to encourage farmers to apply these sorts of management practices. However, in doing so they would look to the proponent to co-operate and support their efforts.

One way the proponents could do this would be to encourage the use of forage harvesters, in preference to mowing, raking and baling the straw. These machines would maximise stubble anchorage. As well, they have the added advantage of leaving untouched the more nutritious components of stubble, the chaff and grain. Hence, on the heavier textured soils only, limited grazing could be undertaken after straw harvesting.

Harvesting Strategy

The above requirements need to be applied and monitored in a way that prevents harvesting occurring on unsuitable soils using unsuitable methods, particularly in years with high straw pulp demand and low stubble supply.

Ultimately, responsibility for monitoring on-farm activities that impact on land degradation lies with the Commissioner of Soil Conservation through the powers and responsibilities of the Soil and Land Conservation Act. Nevertheless, the proponent and the Commissioner need to reach some understanding of shared obligations in this area.

Indeed, there appears to be a good chance that mutually satisfactory arrangements could be agreed. For example, discussions with Mr Ford Murray of River House Pty Ltd, reveal that it may be possible to contract stubbles on farms after grain harvesting but not harvest the stubble until just prior to seedbed preparations for the next crop. This type of strategy would require co-operation with Departmental staff, and perhaps Land Conservation District Committees. Erosion prone soils could be identified for the company well in advance of the negotiations for straw contracts so that where necessary, delayed harvesting requirements could be arranged.

Nutrient Removal

All agricultural activities, including grain and straw harvesting, result in a net export of plant nutrients. On average, each tonne of straw removed contains the following amounts of the major plant nutrients:

Nitrogen	6.0 kg
Phosphorus	0.9 kg
Potassium	13.0 kg

The cost of replacing these nutrients with fertiliser is as follows:

Phosphorus only	$1.00/tonne straw removed
Phosphorus and potassium	$7.63/tonne straw removed
Phosphorus, potassium & nitrogen	$11.33/tonne straw removed

Phosphorus and nitrogen are routinely replaced by fertilisers and, in the case of nitrogen, by using legumes in the rotation. Potassium is not a limiting factor on heavy soils but may become limiting on some of the poorer light soils. Mention of these nutrient depletions and replacement costs should be made in the PER. (The Department has prepared a Technote on this matter, which is attached.)

DISPOSAL OF EFFLUENT AND WASTES

There are two matters of concern regarding effluent and waste disposal which are not adequately addressed in the PER. These relate to the disposal of effluent and solid wastes from the plant.

Effluent Disposal

The proponent proposes to dispose of 2.81 M litres per day of effluent with a salt concentration of 4,800 mg/l (approx equivalent to 870 mS/m). The disposal method proposed is the irrigation of trees on a 1.9 km^2 area, with a 50% leaching fraction.

The Department has some concerns with this proposal in regard to the suitability of the site and the likelihood of off-site degradation.

Site Suitability: The proposed method of effluent disposal requires a site at which the highly saline leachate (9,600 mg/l, if 50% water usage by trees is achieved) will not degrade existing groundwater, stream or land resources.

However, there is room for concern that these resources would suffer degradation. It is possible that the spread of a plume of such leachate in the groundwater would degrade existing high quality groundwater resources in the Leederville formation, west of the Darling Fault, and/or cause the outbreak of saline seeps, in the vicinity of the proposed site and towards the Coonderoo River.

Investigations by this Department indicate that the hydrologic information of the site and surrounding area is insufficient for the proponents to assert it "has been subject to a detailed study" (refer Appendix C). Indeed, our data (one nest of piezometers on the site and reference to available geology and hydrology data) and advice from the proponent's consultants, Peck and Passmore suggest otherwise. Peck and Passmore state (also Appendix C) "a detailed hydrogeological investigation would be required to estimate the rate and direction of movement of this plume" (saline leachate).

Off-site Degradation: The leachate from the proposed tree plot would be considerably more saline (9,600 mg/l) than the waters of the Coonderoo and Moore Rivers (7,400 mg/l). The PER suggests this leachate would seep eastwards to the river. However, surface slope and relief in the vicinity of the proposed site indicate a fall to the east, north and west. Such saline accessions to the local perched water table (see Figure 1) would probably result in both on-site and off-site saline seeps and, possibly, degradation of a nearby native wildflower plantation if they were to move in any of these directions. The tree plot leachate would be substantially more saline than the existing perched water table. Our data show the water table had a summer/autumn, seasonally high salt content of 4,345 mg/l on March 18, 1991. During winter, when the water table would rise, this salt content would normally be considerably less.

Discussions with the proponent's consultant, Dr A Peck, revealed agreement as to the likely effects of off-site degradation between the plant site and the Coonderoo River.

Hence, in addition to the extra site investigations, further exploration of effluent disposal options is clearly required. One such option could be perimeter drainage of the saline leachate from the timber plantation and the piping of this excess effluent to the Coonderoo River.

Waste Disposal

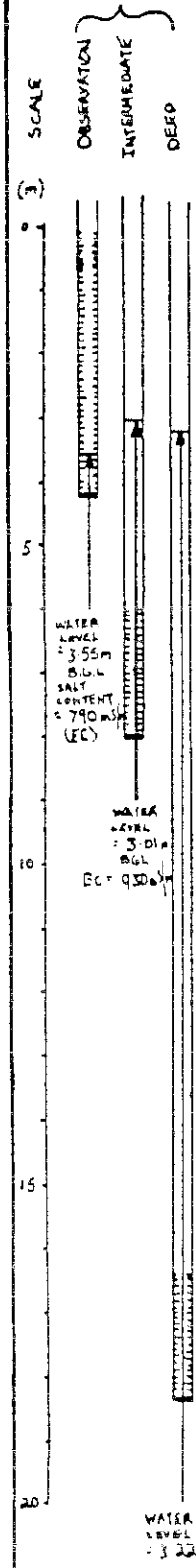
The PER (p34) refers to the major waste product being sodium carbonate produced at the rate of 15 tonnes per day. The proposal to dispose of this waste by landfill needs to be accompanied by more detail before its environmental impact can be properly evaluated.

The alternative idea of the sodium carbonate waste having some value as an amendment for acid soils requires investigation before it is promoted. In terms of neutralizing value, it is roughly equivalent to calcium carbonate. However, the high percentage of sodium would induce undesirable dispersion of the clay fraction of soils. This would pre-dispose the soils on which it was applied to waterlogging and/or runoff and erosion.

FIGURE 1

PIEZOMETER NEST

DRILL DATE: 12/03/91
BORE LOCATION:
115° 59' 94" E (LON)
30° 31' 50" S (LAT)



SOIL DESCRIPTION

SOIL PROFILE	DEPTH	SOIL DESCRIPTION	GEOLOGY	DRILL LOG
	SURFACE	DRY GREY SANDS	QUARTZ	SOFT LOW-RESISTANCE
	0.5-1.5m	DRY BROWNISH YELLOW (10YR 6/6) MEDIUM GRAINED SAND WITH A GRADUAL BOUNDARY TO;		
	2.0	SLIGHTLY MOIST BROWNISH YELLOW CLAYEY FINE SAND.		
	3.0	MOIST BROWNISH YELLOW SANDY CLAY LOAM	QUARTZ - SOME SIZE FRACTIONATION POSSIBLY	MEDIUM RESISTANCE TO DRILL
	[PERCHED WATER TABLE]			
	3.5	MOIST VERY PALE BROWN (10YR 7/4) FINE SANDY CLAY LOAM.		
	4.0	BROWNISH YELLOW (10YR 6/6) SANDY LOAM - GRADUAL BOUNDARY TO SANDY CLAY AT 4.5m.		
	5.0-7.0	VERY DRY, HARD CEMENTED, VERY PALE BROWN COARSE SANDY CLAY (CLAYSTONE)	- QUARTZ - TOURMALINE - FERRUGINOUS PISOLITES % INCREASING AT DEPTH	HARD, HIGH RESISTANCE
	7.0	SATURATED PINKISH WHITE (7.5YR 8/2) SANDY CLAY LOAM.		
	[WATER TABLE]			
	8.0	EXTREMELY HARD WHITE (10YR 8/1) SILTY CLAY		
	9.0-10.0	PINKISH WHITE (7.5YR 8/2) SILTY CLAY LOAM SANDY	QUARTZ	HARD TO MEDIUM DRILL RESISTANCE
	11.0	WHITE (10YR 8/1) FINE SANDY CLAY	QUARTZ	
	12.0	WHITE SILTY CLAY LOAM		
	13.0	PINK (7.5YR 8/4) FINE SANDY CLAY		
	14.0-16.0	PINKISH WHITE (7.5YR 8/2) SANDY CLAY LOAM WITH A GRADUAL BOUNDARY TO PINK SANDY CLAY LOAM AT 16.0m.	QUARTZ	
	18.0	SATURATED [UNCONSOLIDATED TO POORLY CONSOLIDATED] — RED COARSE SAND	QUARTZ	[BORE PRODUCING WATER]
	19.0	VERY PALE BROWN (10YR 7/4) CLAYEY SAND	QUARTZ	SOFT, LOW DRILL RESISTANCE
	20.0	VERY PALE BROWN LOAMY SAND.	QUARTZ	

HORIZONTIC CLAYS

Farmnote
No. 40/90

Western Australian Department of Agriculture

Agdex 571
Wind erosion and control

The amount of stubble needed to reduce wind erosion

By Dan Carter, Research Officer, Soil and Vegetation Management Branch, Albany

This Farmnote details the amount of cereal or lupin stubble needed to reduce wind erosion. It also helps you to predict when a paddock might erode.

The photostandards will help you identify what constitutes an adequate stubble cover.

Wind erosion begins on bare soil surfaces when the wind speed, measured 10 m above ground level, exceeds 30 km/h. The corresponding wind speed at the soil surface would be about 0.3 metres per second or 1 km/h.

To reduce wind erosion, the surface wind speed must be below this threshold, even though the wind speed above the surface exceeds 30 km/h. Surface wind speed can be slowed by maintaining an adequate, stable cover of stubble.

Assessing the erosion hazard

The erosion hazard of a paddock is determined by:

- windiness of the site,
- dryness of the site,
- looseness of the soil surface (that is, the soil surface is easily disturbed), and
- adequacy of the ground cover.

The first condition cannot be controlled, but experience will tell you if winds at a particular site are a problem.

Most areas of the south-west of Western Australia are windy enough over summer and autumn to suffer wind erosion, so there is no escape if the other conditions are conducive to erosion.

You can manage the other conditions by changing grazing rates on the stubbles and by cultivation strategies.

Sheep will remove vegetation and ground cover and dig up and loosen the soil surface if they are allowed. The surface will loosen quickly on sandy soils but this will not be a problem if ground cover is maintained. Even though there might be enough loose soil, the stubble cover prevents the wind from reaching and disturbing it.

Wind erosion starts in the weakest or most exposed part of the paddock, but this initial erosion will not progress unless the rest of the paddock is in a critical condition.

To assess the erosion hazard of the whole paddock you must inspect all parts of the paddock, not just the worst areas. If most of the paddock has less than 50 per cent cover, then remove the sheep.

Sheep camp areas and bare ground around troughs and gates will not be a problem if they are surrounded by adequate stable cover. Sand blown off these areas will be trapped in a short distance by the stable vegetation.

If erosion has progressed, it is likely that the surrounding areas of vegetation were either below the critical levels or unstable. Check this during your overall assessment of the paddock.

Cultivation of stubbles reduces the amount left on the surface. Take this into account when calculating how much stubble should be left after grazing. Generally a scarifier will bury about 30 per cent of the stubble and a disc plough about half.

Stubble requirements for control of wind erosion

The value of vegetative material for control of wind erosion is assessed primarily on the percentage of covered ground. This gives different weights of materials for different kinds of stubble, with the smaller finer stalks such as wheat needing less weight than the coarser lupins.

The critical ground cover percentage is 30 per cent, which means that if all the standing stubble were knocked down on the surface, not less than 30 per cent of the ground would be covered by the straw. However, cultivation will further reduce the amount of stubble so the Department of Agriculture suggests grazing before cultivation should stop when there is 50 per cent cover.

A workable range of coverage is 30 to 60 per cent, with 50 per cent being a safe compromise between only reducing erosion (at a minimal 30 per cent) and having machinery problems that restrict direct drilling operations (at the upper range of 60 per cent).

The stubble should contain at least one-third anchored material, so that there is little movement of loose straw in strong winds and this movement is restricted to within the stubble paddock.

If one third of the stubble is anchored the straw will generally hold firm and maintain the coverage, even against gale force winds.

Maintain an adequate level of anchored plants by not letting sheep over graze and pull out the stubbles.

Cocky chaff and loose leaves provide little protection to the soil, and generally are not considered when assessing the erosion hazard.

In lupin stubbles, the pods occupy significant space and can contribute to the protection given by the stalks.

What weight is left after harvesting?

The table shows how much stubble is left after harvesting 'normal' crops in Western Australia's agricultural rainfall regions and zones. It is based on the stubble yields of the recommended varieties from the Department of Agriculture's crop variety trials.

Knowing the weight of the crop is the important first step in estimating the grazing potential of the stubbles and predicting when a paddock might be an erosion hazard (see 'Estimating grazing potential'.

Grazing sheep eat and trample about 2 kg of stubble per head per day, therefore you can roughly estimate the number of grazing days from the crop yield or stubble left after harvest. You can estimate the grazing days from the time sheep are put into the paddock to the time when stubble cover standards become critical (see table).

If you need six months (180 days) of grazing, then the appropriate stocking rate can be derived from the table by dividing the number of days at 10 DSE/ha by 180 and multiplying the result by 10: for example, 334/180 = 1.86 (x10) = 18.6 DSE/ha.

These estimations take no account of the nutritional requirements of sheep. Hand feed sheep for maintenance of body weight over this period.

If you plan to crop the paddock, leave more residues to compensate for those buried by cultivating implements.

How to use the photostandards

The photographs of the various amounts of stubble are to be used as a guide for estimating the stubble in a paddock.

Two sets of photographs are shown: one taken from the vertical and the other from an oblique angle looking towards the horizon. The latter will give a more natural appearance of the stubble when viewed from some distance. However, the vertical photograph will give the true picture of percentage ground cover.

For cereal crops, 750 kg/ha stubble corresponds to about 30 to 40 per cent standing cover - the critical amount to prevent wind erosion. Because lupin stalks are heavier than cereals, 1,500 kg/ha of lupin stubble is needed to reduce wind erosion.

The photostandards also show levels above and below the critical amount for cereals and lupins.

Use the photostandards a month or two *before* the critical level will be reached - in late summer to early autumn. If most of the paddock, excluding the troughs and camping areas, is at the critical level remove most of the sheep immediately.

If you plan to crop the paddock, keep the amount of stubble after cultivation and seeding above the critical level. As tyned seeding implements tend to bury about 30 per cent of the existing stubble, take this into account when deciding on when to remove stock. The amount of stubble remaining *before* cultivation should be greater than 1 t/ha for cereals and 2 t/ha for lupins.

Estimating grazing potential

Use the following equations to give an approximate guide to the grazing potentials of cereal and lupin stubbles:

$$\text{No. of grazing days (DSE†/ha)} = \frac{[\text{stubble level (kg/ha)} - \text{critical level (kg/ha)}]}{\text{removal rate (2kg/hd/day)} \times \text{stocking rate (DSE/ha)}}$$

OR

$$\text{Stocking rate (DSE/ha)} = \frac{[\text{stubble level (kg/ha)} - \text{critical level (kg/ha)}]}{\text{removal rate (2kg/hd/day)} \times 180 \text{ days}}$$

†DSE = dry sheep equivalent

Critical levels: 750 kg cereal stubble per hectare
1,500 kg lupin stubble per hectare

A range of crop yields and after-harvest stubble yields, with estimates of grazing days to the point of critical ground cover

Type of crop	Crop yields (t/ha)								
Wheat									
Grain yield (t/ha)	4.0	3.6	3.2	2.8	2.4	2.0	1.6	1.2	0.8
Stubble yield (t/ha)	7.4	6.7	5.9	5.2	4.4	3.7	2.9	2.2	1.5
Grazing days (10 DSE/ha)	338	297	260	223	185	148	111	74	37
Oats									
Grain yield (t/ha)	2.0	1.8	1.6	1.4	1.2	1.0	0.8	0.6	0.4
Stubble yield (t/ha)	6.0	5.4	4.8	4.2	3.6	3.0	2.4	1.8	1.2
Grazing days (10 DSE/ha)	263	233	203	173	143	113	83	53	23
Barley									
Grain yield (t/ha)	3.8	3.4	3.0	2.6	2.2	1.8	1.4	1.0	0.6
Stubble yield (t/ha)	6.8	6.0	5.3	4.6	3.9	3.2	2.4	1.8	1.0
Grazing days (10 DSE/ha)	300	265	229	194	158	123	87	51	16
Cereal rye									
Grain yield (t/ha)	2.0	1.8	1.6	1.4	1.2	1.0	0.8	0.6	0.4
Stubble yield (t/ha)	4.9	4.4	3.9	3.4	2.9	2.4	1.9	1.4	0.9
Grazing days (10 DSE/ha)	207	183	158	134	109	85	60	36	11
Triticale									
Grain yield (t/ha)	3.8	3.4	3.0	2.6	2.2	1.8	1.4	1.0	0.6
Stubble yield (t/ha)	8.4	7.6	6.7	5.8	4.9	4.0	3.1	2.2	1.3
Grazing days (10 DSE/ha)	385	341	296	252	207	163	118	74	29
Lupins									
Grain yield (t/ha)	2.0	1.8	1.6	1.4	1.2	1.0	0.8	0.6	0.4
Stubble yield (t/ha)	6.0	5.4	4.8	4.2	3.6	3.0	2.4	1.8	1.2
Grazing days (10 DSE/ha)	225	195	165	135	105	75	45	15	-15

Note: For wheat, 5 bags/acre = approximately 1.0 t/ha

DRAFT

No. /91

Agdex

Harvesting straw for paper pulp: Minimizing wind erosion

By Paul Findlater, Research Officer, Geraldton

Harvesting of excess cereal stubbles for the straw pulp industry should not result in wind erosion, provided a few simple guidelines are followed. Failure to adopt these practices will, however, predispose soils to severe wind erosion.

Causes of wind erosion

Wind erosion will occur on **all** soils when:

- most of the soil surface is made bare;
- there is loose soil on the surface comprised of aggregates of soil particles ranging in size from 0.05 mm to 0.5 mm (the size of coarser silt and fine to medium sand particles); and
- wind strengths exceed 30 km/h.

Agricultural practices such as grazing, straw harvesting, burning and tillage either remove or bury the protective ground cover and disturb the soil leaving it in an erodible state.

Paddocks are more at risk where they have low quantities of stubble and the soil is easily broken down into small erodible fragments of the sizes mentioned above.

Harvesting cereal straw for paper pulp can be safely undertaken **only** where there is plenty of straw that can be harvested in such a manner as to leave short stalks of stubble (10 cm length) **and** where such stubbles occur on soils which do not easily fragment into erodible sized particles when grazed or cultivated.

Most suitable paddocks

The paddocks most suitable for straw harvesting and least at risk from erosion in the Moora district are those with soils commonly known as York gum and Salmon gum soils. (Figure 1)

The York gum soils (red brown earths) have loamy surfaces. They are mainly in a belt from about 50 km due north of Moora south to Gingin.

The Salmon gum soils (solonized brown soils) have dark reddish-brown sandy loam surfaces and occur within a 30 km radius of Dalwallinu and Ballidu.

These medium to heavy textured soils are reasonably resistant to disturbance, and after rain will readily form a protective crust against wind erosion. In the Moora district, these soils are the most productive, producing large quantities of cereal stubbles.

Straw harvesting on these soils will normally leave sufficient quantity of short stalks of cereal stubble to protect the surface from wind. Furthermore, these soils will also produce stubbles of good quality, well suited for supply to the pulp mill.

Marginally suitable paddocks

Paddocks with soils containing large amounts of ironstone gravel on their surface with reasonable levels of clay may be suitable, provided they are not grazed and the preceding crop yielded well, leaving a large quantity of stubble.

Unsuitable paddocks

Soils with sandy surfaces are **not** suitable for stubble harvesting. Most importantly, they are highly liable to erode. Also, their straw will often be contaminated with sand, and the stubble quantities will not be great enough for an economic return from such harvesting.

Safe quantities of stubble after harvest

The quantity of stubble needed to protect the soil will vary depending on whether it is standing or has been knocked down by grazing or cultivation (Figures 2 and 3).

When knocked down, about half of the surface needs to be covered by stubble (this figure translates to 1.0 t/ha) to prevent wind erosion. Furthermore, most of this stubble needs to be anchored to the soil surface by its roots.

Less stubble is required to protect the soil surface (about 30 per cent ground cover) if the stubbles are standing.

To prevent wind erosion, it is crucial that these minimum levels of stubble cover remain after straw has been harvested. If the stubble is raked, the quantities of straw removed can be controlled by the setting of the height and angle of the rake and by restricting the number of rake passes.

Stubble quantities to be retained if cropping next year

If the harvested paddock is to be cropped in the following year, at least twice these quantities of stubble are required. This amount is required because at least half the amount of stubble remaining on the soil surface is buried during the cultivation and seeding operations for the following crop.

Grazing management

Stubbles should be only grazed **before** the straw is harvested. This will ensure that the stock gain the maximum nutritional benefit from the grazing by being able to eat any split grain and leaf. There is little if any nutritional or economic value in grazing the stems. Grazing may aid harvesting by knocking stubbles over, allowing the loose straw to be raked into windrows and baled.

If a small part of a farm is cropped and stubbles are relied upon for summer grazing, the need to retain enough cereal stubble for both stock feed and control of wind erosion may make the harvesting of stubble impossible. As the cropped area increases, the harvesting of cereal stubbles without risking wind erosion becomes easier to accomplish.

Further information

- Additional information on stubble levels and grazing can be obtained from Farmnote No. 40/90 'The amount of stubble needed to reduce wind erosion' (Agdex 571).
- Detailed descriptions and photographs of the major soils can be obtained from Bulletin No. 4182 'An introduction to the soils of the Moora Advisory District' (Agdex 524).

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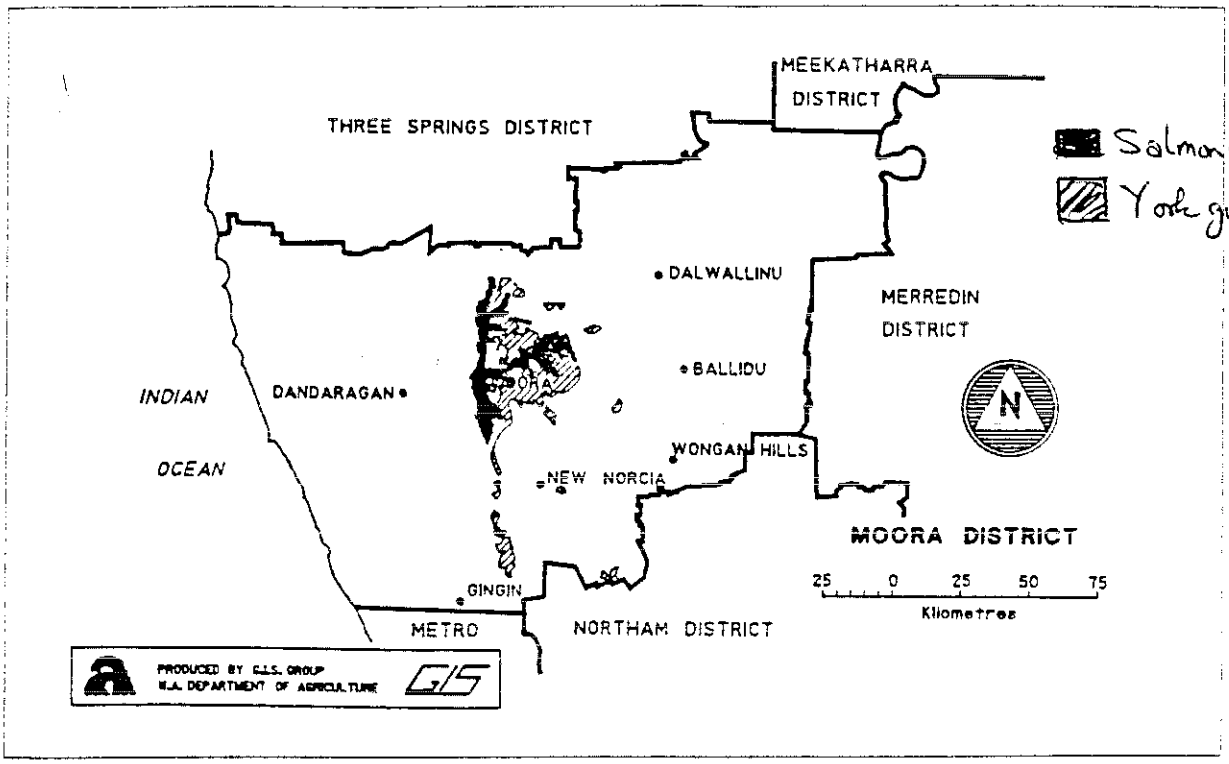

Figure 1. Paddocks of these soils will be most suitable for growing crops for straw harvesting.

Figure 2. The minimum stubble to prevent wind erosion when knocked down (1 t/ha).

Figure 3. The minimum standing stubble to prevent wind erosion (30% ground cover).

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No. 1/91

Agdex 532
Plant nutrition

Nutrient removal by wheat crops

By J.W. Gartrell, Plant Nutrition, Division of Plant Industries

Nutrient concentrations in wheat plants and their different parts vary greatly depending on season, management practices, available soil nutrient levels and variety. The ranges of the amounts of nutrients commonly found in wheat grain and straw in West Australian crops are shown in Table 1. Tables 2, 3 and 4 show amounts of nutrients removed in one tonne of "typical" grain, straw (stubble left after havesting grain) and hay, and the cost of fertilizers which would replace the mineral nutrients removed in products.

Points to note

1. To maintain the level of plant-available nutrients in the soil in successive wheat cropping systems, more nutrients must be applied than the amounts removed in crop products. This is to compensate for losses other than in crop products. The nature and extent of other losses vary between nutrients, soil properties and the amount and seasonal distribution of rainfall.

   Nitrogen is most prone to losses by biological processes and leaching. Commonly the amount of fertilizer nitrogen needed to maintain fertility is double the amount of nitrogen removed in crop products.

   Phosphorus is most prone to losses in solubility caused by chemical reactions ("fixation" and "reversion"). Phosphorus only leaches out of the profiles of pale, coarse sands with high rainfall. Losses of phosphorus by fixation in Western Australian soils are in the range of 2 to 10 kg P/ha/a with about 4 kg P/ha being most common.

   Potassium is prone to leaching on soils low in colloids (clays and organic matter) in high rainfall areas. Only on very sandy soils in the wetter parts of the wheatbelt are potassium losses by leaching likely to be significant.

   For trace elements, the amounts removed in crop products have a negligible effect on their supply, in plant-available form, in soils.

2. Potassium removal in one tonne of hay or stubble is much higher than in one tonne of grain. Many of sandy soils have quite low reserves of plant-available potassium. The need to replace potassium removed in crop products will become increasingly common, particularly where straw or hay is repeatedly removed from the paddock. Replacement of potassium (K) is unnecessary on soils with more than 120 ppm bicarbonate extractable K in the top 10 cm.
3. Most Western Australian soils have large reserves of plant-available magnesium. Magnesium deficiency rarely occurs in the wheat growing areas of Western Australia.
4. Periodic applications of superphosphate are usually sufficient to replace the calcium and sulphur in crop products.
5. The needs for application or re-application of the trace elements are almost entirely governed by processes other than product removal.
6. In rotations of wheat with legumes the legumes may, for little or no cost, add more nitrogen to the soil than that removed in crop products.
7. Burning cereal stubble causes little or no direct loss of plant-available nutrients. However, important quantities of nutrients may be lost if burning the stubble allows severe wind erosion that would not otherwise have occurred.

Table 1. Common ranges of mineral nutrients in wheat grain and straw found in Western Australian crops

	Mineral element content (kg)								
	N	P	K	S	Mg	Ca	Cu	Zn	Mn
In 1 tonne of Grain	16 -26	2.0 -3.5	3.0 -7.0	2.0 -3.0	1.0 -1.5	0.2 -0.4	0.002 -0.004	0.015 -0.30	0.01 -0.05
In 1 tonne of Straw	2 -10	0.2 -1.5	6.0 -16.0	0.4 1.5	0.5 -1.0	0.6 -2.0	0.001 -0.003	0.01 -0.03	0.01 -0.06

Table 2. Cost of replacing nutrients removed in 1 tonne of grain with "typical" nutrient levels, using an appropriate type of fertilizer (1990 prices)

Nutrient element	Amount in 1 t grain (kg)	Fertilizer type and rate (kg/ha)	Approx. cost 150 km from Perth ($)
N	20	Urea 43	(a) 14.60
P	2.5	OSP 27.5†	5.00
K	4	KCl 8††	2.70
S	3	Supplied by OSP	Nil
Mg	1	Dolomite 7	0.40
Ca	0.3	Supplied by OSP	Nil

† OSP - Ordinary superphosphate (9.1% P)
†† KCl - Muriate of potash
Note
(a) Cost of nitrogen may be zero if legumes are grown in rotation with wheat.
(b) Costs of trace elements removed are negligible.
(c) Replacement of potassium (K) is unnecessary on soils with more than 120 ppm bicarbonate extractable K in the top 10 cm.

Table 3. Cost of replacing nutrients removed in 1 tonne of wheat straw with "typical" levels, using an appropriate type of fertilizer (1990 prices)

Nutrient element	Amount in 1 t straw (kg)	Fertilizer type and rate (kg/ha)	Approx. cost 150 km from Perth ($)
N	5	Urea 11	(a) 3.70
P	0.5	OSP 5.5†	1.00
K	10	KCl 20††	6.60
S	0.5	Supplied by OSP	Nil
Mg	0.7	Dolomite 5	0.25
Ca	1	Supplied by OSP	Nil

† OSP - Ordinary superphosphate
†† KCl - Muriate of potash
Note
(a) Cost of nitrogen may be zero if legumes are grown in rotation with wheat.
(b) Costs of trace elements removed are negligible.
(c) Replacement of potassium (K) is unnecessary on soils with more than 120 ppm bicarbonate extractable K in the top 10 cm.

Table 4. Cost of replacing nutrients in 1 tonne of wheaten hay cut at the soft dough stage with "typical" nutrient levels using an appropriate type of fertilizer (1990 prices)

Nutrient element	Amount in 1 t hay (kg)	Fertilizer type and rate (kg/ha)	Approx. cost 150 km from Perth ($)
N	16	Urea 34.5	(a) 11.70
P	2.1	OSP 23†	4.20
K	12	KCl 24††	7.90
S	1.5	Supplied by OSP	Nil
Mg	1	Dolomite 7	0.40
Ca	1	Supplied by OSP	Nil

† OSP - Ordinary superphosphate
†† KCl - Muriate of potash
Note
(a) Cost of nitrogen may be zero if legumes are grown in rotations with wheat.
(b) Cost of trace elements removed are negligible.
(c) Replacement of potassium (K) is unnecessary on soils with more than 120 ppm bicarbonate extractable K in the top 10 cm.