Development Act 1993

ASSESSMENT REPORT

For the Environmental Impact Statement for the

IWS Northern Balefill

Minister for Transport and Urban Planning
South Australia

ASSESSMENT REPORT

FOR THE ENVIRONMENTAL IMPACT STATEMENT FOR

THE

IWS NORTHERN BALEFILL

(FORMERLY THE SOLID WASTE BALEFILL - P & M BORRELLI & SONS PTY LTD)

MINISTER FOR TRANSPORT AND URBAN PLANNING
SOUTH AUSTRALIA

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EXECUTIVE SUMMARY

This Environmental Impact Assessment (EIA) is being undertaken under Section 46 of the *Development Act 1993*. On 19 October 1994 the then Minister for Housing, Urban Development and Local Government Relations stated that an Environmental Impact Statement (EIS) was required for the development, by P & M Borrelli & Sons Pty Ltd, of a solid waste landfill depot in the District Council of Mallala. Guidelines for the EIS were issued and the *Solid Waste Balefill Environmental Impact Study at Mallala* was prepared by the proponent and placed on public display from 22 April 1996 to 7 June 1996. A public meeting to discuss the EIA process and the proposal was held by the Department of Housing and Urban Development on 15 May 1996. A response document titled *EIS Solid Waste Balefill - Response to Submissions*, in which the proponent responded to 49 public and government submissions, was released on 10 June 1997.

The EIS, the public and government agency submissions and the Response document, the comments of the Environment Protection Authority (EPA), the relevant Council (the District Council of Mallala), the Native Vegetation Council and other information have been considered in the preparation of this Assessment Report.

Integrated Waste Services Pty Ltd (IWS) (formerly P & M Borrelli & Sons Pty Ltd) propose to establish an above ground balefill, to be known as the IWS Northern Balefill, 3km south of Dublin ie. 50km north of Adelaide. The whole of the subject land is zoned as General Farming within the Development Plan for the District Council of Mallala.

Separate to this proposal, the proponent has been given Provisional Development Plan Consent, by the Development Assessment Commission decision on 13 May 1997, to construct a resource recovery, shredding and baling facility at Wingfield (IWS Wingfield Resource Recovery and Transfer Facility).

The proponent's existing landfill facility at Wingfield is approved to the year 2000 with ongoing use through the transfer station. With the closure of the Wingfield site for waste disposal, IWS require a site for the final disposal of shredded and baled waste and demolition and inert waste. The selected site is considered by the proponent to provide an opportunity to establish a commercially sustainable, environmentally sound balefill waste disposal facility, with a capacity of approximately 20,000,000 cubic metres and an estimated lifespan of 60 to 80 years.

The balefill (landfill) would receive processed waste products as part of an overall waste management strategy of recycling and waste minimisation to be undertaken at the baling facility. At the landfill site it is proposed to also store selected wastes, which may have potential to become future resources, in dedicated cells.

The locality is predominantly flat plains, with the subject land sloping gently down from east to west over its entire distance (approximately 4.5km), with a fall of about 10m (ie. 14-4m AHD). The land is generally open and rocky; extensive grazing has reduced native vegetation and the area is infested with rabbits and pest plants.

Soils on the site are of the mallee type overlying sheet calcrete of the type Ripon Calcrete, which in turn overlies low permeability Hindmarsh Clay some 45 - 55m thick. Below the clay is the confined aquifer of the Port Willunga Formation. Salinities of water in this aquifer range from 4000 - 7000mg/L restricting its suitability to stock watering or industrial use.

More recently part of the land has been excavated for its calcrete for road construction. Limited rehabilitation has taken place and consequently there has been no regrowth or revegetation in the excavated areas.

Adjacent land use is grazing, feedlotting, piggeries, poultry sheds and associated agricultural activities.

The proponent has researched internationally and believes that this proposal uses state of the art landfill techniques so ensuring that it is environmentally and technically acceptable to the community.

The proponent has made a commitment to operate according to a management plan based on a "continual improvement philosophy which allows for modification of practices to achieve performance improvements in operation, environmental and licence compliance". As part of this management plan a local community consultation committee is proposed.

The EIS and Response documents provide details of site preparation, operational procedures, potential environmental impacts of the project, together with proposed mitigation measures and long term rehabilitation proposals. Issues discussed are:

- groundwater;
- leachates;
- landfill gas and odour;
- operational staging;
- surface water management;
- buffers/visual amenity;
- proximity to dwellings;
- litter/dust;
- noise/traffic;
- meteorology;
- sea level rise;
- site rehabilitation;
- post closure management.

The proponent has stated that all impacts will be minimal and, where problems could arise, suitable mitigation measures would be applied to alleviate the problem. The proponent is confident that this proposal meets the established policies and objectives of the EPA.

IWS intend to incorporate a financial assurance package that is to the satisfaction of the EPA, in accordance with industry standards, with funds allocated to cover the liability for current operations together with ongoing monitoring and post closure programs.

The EPA has concluded on 11 September 1997 that,

> "…the proposed site for the IWS balefill could be developed to its satisfaction provided that high standard environmental management systems and practices are established and maintained for the active life of the facility and post closure monitoring period." (Refer Appendix A for details).

The Assessment Report concludes that the proponent has demonstrated that the site is suitable for development as a landfill/balefill facility. The proposal's operational procedures, as documented through the EIS, Response document and Clarification of Issues document, provide confidence in the proposal.

1 INTRODUCTION

This Assessment Report, prepared by the Minister for Transport and Urban Planning, assesses the social, economic and environmental impacts of the proposed balefill depot in the District Council of Mallala. While the Report is intended to be a "stand-alone" document the detailed information on which it is based is contained within the *Solid Waste Balefill Environmental Impact Statement Study at Mallala* (EIS), *EIS Solid Waste Balefill Response to Submissions* (Response document) and *Solid Waste Balefill - Clarification of Issues*, (prepared for the EPA), which are all publicly available.

Reference has been made in the EIS and Response document to the EPA document "Interim Criteria for Major Landfill Depots" (SA-EPA Interim Criteria). Several draft versions of this document have been issued during the consideration of this proposal. The "Consultation Draft October 1997", was released for public comment on 30 October, 1997 for submissions by 12 December, 1997.

1.1 THE PROPOSAL

Details of the proposal are set out in Section 1.6 of the EIS and Sections 2.1 and 2.2 of the Response document.

Integrated Waste Services Pty Ltd (IWS), formerly known as P & M Borrelli & Sons Pty Ltd, propose to develop a balefill on farming land situated near Dublin in the District Council of Mallala, the facility is to be known as the IWS Northern Balefill.

The balefill would be a regional waste disposal site for central and northern metropolitan Adelaide, providing waste disposal/landfill space for approximately 20 million cubic metres of municipal solid waste over a 60 to 80 year lifespan. Final landforms would be at 23 metres (m) Australian Height Datum (AHD) at their highest point (ie. 9m above the level of Port Wakefield Road at the site access point).

The site itself is located in a rural area, approximately 50km north of the Adelaide CBD (Map 1), and was chosen based on the availability of suitable land. The site has been severely degraded through the clearance of native vegetation, subsequent grazing and invasion of pests (particularly rabbits).

A portion of the site and other land in the locality have been recently excavated for calcrete, which was used in the development of National Highway 1.

The proposal is principally a **balefill** method of landfilling - where waste is delivered to the site in an already baled and compacted form from a new Resource Recovery and Transfer Facility on an existing waste management site at Wingfield. Provisional Development Plan Consent for this latter facility was given by the Development Assessment Commission in May 1997. Unbaled material would comprise demolition and inert wastes.

The balefill cells would be developed such that separate materials baled at Wingfield may be stored in different cells. Should future technologies enable the use of that material as a secondary resource, the material would be able to be recovered for that purpose in the future.

Individual bales would be a maximum size of 1.2m wide, 0.8m high and 1.6m long and weigh approximately 1.2 tonnes. A typical cell would be 150m x 150m with a maximum working face 50m wide. Each lift would consist of 3 bales plus daily cover to obtain maximum efficiency. At an average weekly intake of 2,000 tonnes of baled waste it would take approximately 9 to 12 months to complete a cell.

Balefill cells would be self contained with full environmental controls including groundwater control, base liner system, leachate collection system, daily/intermediate/final cover system, landfill gas control system.

Progressive landfill staging, completion, revegetation and rehabilitation, moving away from Port Wakefield Road and existing dwellings, would be a standard operational procedure.

Low permeability clays (Hindmarsh Clay) underlying the site would be re-engineered and utilised as a lining for landfill cells.

Stormwater management systems have been designed to prevent concentration of flows, minimise sediment load and divert flows away from balefill zones. Separated leachate and surface water management and treatment systems and landfill gas (LFG) control and extraction systems are proposed.

Extensive landscaping incorporating existing remnant stands of native vegetation and revegetation of perimeter buffer zones is proposed. Environmental monitoring and post closure planning would be undertaken in accordance with statutory requirements.

In addition the proposal would provide infrastructure such as a weighbridge, office, rejected vehicle turning path, sealed entrance roadway and vehicle wheel wash.

In response to government and public submissions received during the display period, the proponent has revised aspects of the proposal (Response, Section 2.2) to include:

- relocation of the perimeter of the landfill cells to a minimum of 520m distance from residences compared with the 400m in the EIS, and to provide wider vegetation buffers;

- the landform has been modified to meet the SA-EPA interim criteria. This has resulted in a revised shape and increased height from 18m to 23m AHD and revision of the proposed groundwater protection system;

- reworking of the staging to widen gaps between the areas comprising the landfill stages to allow stormwater flow paths to be maintained, to improve the visual aspect of the site, operational maintenance, fire protection benefits and environmental performance criteria;

- reordering the proposed staging to maximise the benefit of buffering of the operations by the first stages;

- the buffer between the Penrice mining leases (western) has also been increased from 25m to 500m;

- revision of landfill cell engineering details to ensure environmentally sound construction, operation and monitoring features, particularly groundwater protection and leachate control;

- community consultation and input - the proponent would be required to prepare a Landfill Environmental Management Plan (LEMP) as a condition of licensing by the EPA, which incorporates ongoing management and liaison with the community including consultation and input into future use and management of the land;

- waste type control - incorporated in the LEMP will be the requirement that any waste delivered for disposal must have passed through an accredited, licensed Resource Recovery Facility. The accreditation would be based on the protocol for management of wastes including a recording process to identify source of material, and its storage location on site.

1.2 ENVIRONMENTAL IMPACT ASSESSMENT PROCEDURES

Procedures for Environmental Impact Assessment (EIA) for Major Developments or Projects in South Australia are set out in Sections 46, 47 and 48 of the *Development Act 1993*.

At the time the proposal was submitted, the Minister formed the opinion that this development was of major social, economic or environmental importance under Section 46 of the *Development Act 1993*. On 19th October 1994 the Minister required an Environmental Impact Statement (EIS) for the IWS proposal to develop a landfill in the District Council of Mallala and draft *Guidelines* outlining the scope of the EIS were subsequently placed on public exhibition for one month, during which period comments were received from the community and government agencies.

The proponent conducted baseline studies and prepared an EIS which was placed on public display for a period of 8 weeks, (April to June 1996), during which time Government agency and public comments were invited.

Following the display period the proponent prepared a Response document (*EIS Solid Waste Balefill Response to Submissions*) addressing matters raised in public submissions and government comments on the EIS.

Pursuant to Section 46 (9) of the *Development Act 1993*, in this Assessment Report, the Minister has taken into account the EIS, the submissions and the proponent's response to the submissions, the comments of the EPA and the District Council of Mallala, the Native Vegetation Council and any other matters the Minister has considered appropriate.

On completion of the Assessment Report the Governor, pursuant to Section 48(7) of the *Development Act 1993* must, when making a decision, have regard to the provisions of the appropriate Development Plan and the relevant regulations, building rules (if relevant), and the Planning Strategy. Further, when making a decision on an "activity of environmental significance" as listed in the Act, the Governor must have regard to certain provisions of the *Environment Protection Act 1993*. In particular, the Governor must have regard to the Objects of the Act, the general environmental duty under the Act and any relevant environment protection policies. The Governor must also, pursuant to Section 48 (5)(e) of the *Development Act 1993*, have regard to the EIS and the Assessment Report. Further, in Section 48 (7) the Governor may specify conditions which should be attached to a development authorisation that must be complied with in

the future and under some circumstances may vary or revoke conditions to which the development authorisation is subject or attach new conditions to the development authorisation.

This Report considers the development concept as defined by the EIS and Response document in total, and further clarified by additional documentation. Additional specific information would be required in a Landfill Environmental Management Plan (LEMP) which would address monitoring and mitigation measures to satisfactorily ameliorate impacts. A satisfactory LEMP would be required by the EPA for licensing purposes. Licensing requirements, which address operational aspects and issues, may be subject to variation in the future without amendment to any development authorisation for the proposal, which predominantly addresses land use matters.

1.3 PUBLIC CONSULTATION

The *Development Act 1993* allows for public input during the exhibition of the draft *Guidelines* and the EIS, by inviting written comment. In addition, the EIA Branch of the former Department of Housing and Urban Development (DHUD) conducted a public meeting during the exhibition period of the EIS.

Draft *Guidelines* outlining the scope of the EIS were placed on public display for 1 month on 5 December 1994.

The EIS was placed on public exhibition for 8 weeks from 24 April 1996 to 7 June 1996. During this time the Minister received 40 submissions from the public and 9 submissions from government departments and agencies. All submissions were forwarded to the proponent, Integrated Waste Services Pty Ltd.

The issues raised in the submissions were analysed and the proponent's responses set out in the Response document, released on 10 June 1997. Key issues raised were:

- impacts of litter, vermin, odour, dust, noise;
- potential to pollute the Gulf of St Vincent;
- engineering (base of landfill) aspects of the proposal;
- zoning requirements;
- adequacy of meteorological data;
- land values;
- health impacts;
- traffic on Port Wakefield Road;
- adequacy of buffers;
- groundwater flow management;
- leachate management.

The public meeting convened by the former DHUD was held on 15 May 1996 and attended by approximately 150 people. Representatives from DHUD, the Office of Environment Protection and Integrated Waste Services Pty Ltd were present to provide information on the assessment process and the proposal as outlined in the EIS document.

1.4 AGENCY, PRESCRIBED AUTHORITY AND COUNCIL CONSULTATION

The Office of Environment Protection (OEP) was consulted at each stage of the assessment process. Section 46B (5) and (9) of the *Development Act 1993* requires that the EPA is consulted and EPA comments are set out or included in the assessment. The EPA comments and report (received in September 1997) addressed the EIS and the Response documents. The statutory requirement is for the EPA to comment and report on the EIS, no formal mechanism exists to require comment on the Response document, however EPA (and OEP) input is integral to an assessment of a landfill activity. A copy of the EPA comments concerning the proposal is provided in Appendix A of this Report.

The amendments to the Act in January 1997 also required that the relevant Council in whose area the development is proposed, be consulted and their comments set out or included in the Assessment Report . The exhibition of this EIS occurred prior to those amendments however the Council comments are included in Appendix C1 and C2 to this assessment as required by the amended Act.

The Native Vegetation Council was also consulted pursuant to Regulation 3 of *the Native Vegetation Regulations 1991*. Their comment is included wholly in Appendix D.

Other Government agencies provided comment in relation to various aspects of the proposal and these are outlined in the appropriate places in this Report.

2. PROJECT DESCRIPTION

This chapter summarises the proposed development with respect to site facilities, method and hours of operation (including procedures for site management) and environmental protection measures, details of which are set out in the EIS and Response document.

2.1 PROJECT JUSTIFICATION

The EIS (Section 1.4) states that the proponent's existing landfill facility at Wingfield is approved until the year 2000 and to continue operating a commercially sustainable, orderly and attractive waste management service, a new facility will be required. In relation to the proposal the proponent provides a series of company objectives and lists the aims of the proposal (EIS, Section 1.7).

Further, (EIS, Section 1.8) the proponent believes that, given the majority of Adelaide's landfills will be closing in the next 10 years, this proposal is consistent with the Environmental Protection Authority's (EPA) regionalisation and rationalisation program for waste depot locations.

The Office of Environment Protection in their submission of 24 June 1996 stated that,

> "The basic concept of the proposal is, however, broadly consistent with the principles embodied in the EPA's Integrated Waste Management Strategy Discussion Paper."

The EPA has since concluded on 11 September 1997 that,

> "…the proposed site for the IWS balefill could be developed to its satisfaction provided that high standard environmental management systems and practices are established and maintained for the active life of the facility and post closure monitoring period." (Refer Appendix A for details).

2.2 PROPOSED SITE

The proposed balefill site is located 50 km north of Adelaide, approximately 3 km south of Dublin and to the west of Port Wakefield Road (Map 1).

The land on which the proposed balefill is to be developed is zoned General Farming (GF) in the Development Plan for the District Council of Mallala. Under the principles of development control for the zone, the proposed activity was considered a merit application at the time of the preparation of the EIS. Subsequently the Council has prepared a Plan Amendment Report in which the proposal became non-complying, the Amendment was authorised on 1 May 1997.

The site under consideration comprises:

Table 2.1 Certificates of Title *

Volume	Folio	Other Description	Section	Hundred
3465	50		310	Dublin
3465	55		312	Dublin
3469	82		311	Dublin
4056	704		Portion 304	Dublin
4056	705		Portion 304	Dublin
4056	706		Portion 305	Dublin
4056	707		Portion 305	Dublin
4056	708		Portion 304	Dublin
5312	333	Allotment 76 in Deposited Plan 26412		Dublin

**(EIS, Section 2.2.3)*

The total land area is approximately 455 hectares of which approximately 298 hectares would be used for the balefill.

The site is predominantly flat with a gentle slope from 14m AHD in the east (adjacent to Pt Wakefield Road) to 4m AHD on the western boundary, a distance of 4.5 km.

Most of the area has been cleared of its native vegetation with only a few stands remaining (EIS, Section 2.7). The site has been heavily grazed which together with limited cropping has resulted in severe degradation and subsequent pest plant and rabbit infestation. Extraction of the calcrete has taken place in the eastern portion of the site for the upgrading of Port Wakefield Road. Partial restoration has taken place but there has been no revegetation or regrowth in the mined areas. Currently the site is being used for grazing.

The site is characterised by a thin layer of Ripon Calcrete overlying generally low permeability Hindmarsh Clay (40-50m thick). Below this is the confined aquifer of the Port Willunga Formation with water salinities of 4000-7000 mg/L limiting it to stock watering or industrial use.

The whole of the land is owned by Integrated Waste Services Pty Ltd (Response, Section 1.4).

2.3 PROPOSED DEVELOPMENT

This section describes the proposed development and outlines the proposed method of operation.

2.3.1 Method of Operation

Site Preparation

Prior to landfill liner construction, the hard veneer of calcrete overlying the site would be ripped and removed. The crushed material could be used for onsite roads and hardstand areas (Response, Section 5.1).

Cell staging would take place progressively (Figure 1) commencing from the eastern boundary (adjacent to Port Wakefield Road) and working towards the west (Response, Section 2.21 and Figure 2.2).

Development would be over 9 stages with individual stages containing between 6 to 14 cells, each measuring 150m x 150m (Response, Section 4.5). Cell preparation would consist of installation of a groundwater interception system, preparation of a 1m thick clay liner (Figure 2) to a 1×10^{-9}m/s or lesser permeability and the installation of a leachate collection system. The quality of liner compaction to meet specification would be achieved by preparing three compacted layers to make up the full liner. Geotechnical testing would be carried out by a NATA registered authority. Areas that fail the test would be reworked to meet the specification. The liner system would be constructed over the whole landfill base and extended up the sides, to provide full encapsulation. Groundwater levels would be maintained below construction level until each cell was capped (Response, Section 5.3). The leachate drainage system would consist of a high porosity material (gravel or geonet) sloped at 2% to collection drains run at 1% slope to the external sump. This would provide a preferential path for any leachate to flow to the external collection sump. A groundwater control system is proposed to prevent localised fluctuations of the watertable from subjecting the liner to uplift prior to bale placement. The hydrogeological aspects of this are discussed in the EIS (Section 7.2), and the Response document (Section 2.2.3 and Figure 2.4), and assessed in Section 4.7 of this Report. Liner material would be obtained from the site (Response, Section 2.2.2).

Site Operation

Bales would be delivered from the IWS Wingfield Resource Recovery and Transfer Facility to the site in covered vehicles and unloaded and placed in the cell by a fork lift (Response, Section 2.2.3 and 4.6). Waste would be received between 7.00 am and 7.00 pm seven days per week (Response, Section 4.6). Interim and daily cover would be sloped to ensure drainage of surface water away from waste disposal areas.

Individual bales measuring 1.2m wide, 0.8m high and 1.6m long and weighing between 0.8 and 1.2 tonnes would be placed in the cell. Using a working face 50m wide, each lift would comprise 3 bales plus daily cover. With an average weekly intake of 2000 tonnes of baled waste it is expected to take between 9 to 12 months to fill a cell.

Operational waste cells would be progressively capped with a 0.6m thick low permeability clay cap directly above the waste, overlain by a 0.6m thick layer of plant growing and moisture control medium. The cap is to be sloped at least 3% to ensure surface water drainage resulting in minimal infiltration of rainwater (Response, Section 2.2.3).

Landfill gas collection pipes are to be installed in each cell, this is discussed further in Section 2.3.2 of this Report.

Daily cover material would be obtained from the site (Response, Section 2.2.2).

Surface water diversion and storage were discussed in the Response document (Section 2.2.4). The staging would allow for the natural drainage paths of the site to be retained, so preventing any off site adverse impacts occurring. Both internal and external surface water drains would be

provided, with respective holding ponds, or dams, on the site. Runoff from waste disposal areas would have a separate collection and holding system.

The proponent has also stated that there would be ample provision for checking material entering the site, and only material from approved recovery or transfer facilities would be received (Response, Section 4.1). Should it become necessary to accept waste from surrounding areas, a recovery and baling facility could be constructed on the site (Response, Section 4.1). The proponent has also indicated (J. Borrelli pers. comm. May 97) that material that may have an economic value at some later time will be logged and stored in accessible cells.

The proponent recognises that for a long duration project, there needs to be a mechanism for upgrading site operational practices to reflect advances in waste handling and treatment/disposal methods, as they become economically viable. The proposed layout shown in the Response document with independent stages and cells, allows changes to the design philosophy with no implications for previous balefill stages. This is unlike conventional landfills where waste, leachate, groundwater and gas control systems are connected across stages. The design therefore incorporates the flexibility to allow continuous improvement subject to the approval of the relevant authorities (IWS pers. comm. Aug 97).

2.3.2 Leachate and Air Emissions

As stated in the EIS (Section 7.2) and Section 2.3.1 of this Report, a leachate collection system would be installed in each cell prior to filling the cell. The proponent has stated that, with this method of waste disposal, there is little likelihood of leachate being formed (EIS, Section 8.4). Notwithstanding this statement, which has been confirmed by computer modelling (Response, Section 5.4 and Appendix A) a leachate collection system would be installed (Response, Section 2.2.3 and Figure 2.4). An outline of what is proposed is described in Section 2.3.1 of this Report. The revised staging would allow for "progressive stage closure" to take place. Each cell would be provided with separate leachate and groundwater collection systems and sumps. This allows for monitoring of leachate and groundwater quality on a cell by cell basis resulting in rapid detection of contaminants and application of mitigation measures in the event of leachate escape from a cell. A system of monitoring wells is proposed (Response, Section 5.7 and Figures 4.3 and 5.5).

While a number of leachate treatment methods were proposed in the Response document (Section 5.6) evaporation in clay lined ponds is the simplest option. Design of the pond would consider leachate and stormwater separation before the complete coverage of the cell floor with waste and daily cover.

The Response document (Section 5.5 and Appendix A) provides detailed calculations on a number of scenarios related to leachate production and was analysed by the OEP. The effectiveness of what is proposed is discussed in Section 4.7 of this Report.

The proponent states (EIS, Section 12.3.3) that the balefill method would ensure no odours will be detectable beyond the immediate working area. Further in the Response document (Section 9.2.1), it is stated that given the meteorological conditions at the site, the buffer distances provided and the balefill method of disposal, odours from the active cell would rarely be detected.

A series of landfill gas collection pipes would be installed progressively in each cell to facilitate the removal of gas from the facility (Response, Section 2.2.5). Extracted gas would be either flared or utilised commercially (EIS, Section 8.3 and Response, Section 7.3).

The potential for landfill gas to migrate through the liner would be controlled by utilising a vacuum extraction technique, effectively reducing the pressure within each cell (Response, Section 7.5). Gas monitoring wells are to be placed around the perimeter of each cell ensuring early detection and remedial action of any leakage (Response, Section 7.5).

2.3.3 Pest Plants, Vermin and Litter

The EIS (Section 3.15) identifies 10 introduced plant species of which 2 are considered for eradication. While not specifically stated, eradication should take place during normal operational procedures and any revegetation activities. The introduction of weed species would be controlled (Response, Section 9.4) in several ways viz.

- no bulk vegetation to be accepted for landfilling;
- all baled and shredded waste not conducive to weed growth;
- transfer trucks to pass through wheel wash.

The proponent makes a commitment to the control of scavenging birds and rats, mice and flies (EIS, Section 10.10) by appropriate fencing to keep out large vermin and use of a professional pest exterminator where normal management practices are ineffective. The Response document (Section 9.4) states the Landfill Environmental Management Plan (LEMP) will establish an appropriate monitoring program. There is a commitment to reviewing the control measures, as required, and making results available to the relevant authority.

The EIS (Section 10.6) and Response document (Section 9.2.2) discuss litter control methods. While little or no windblown litter is predicted, given the nature of the balefill operation, each working area of a cell would have a 1.8m high relocatable fence around it to contain fugitive material - most probably resulting from a broken bale. Inspection and collection of litter would take place around the perimeter of the site.

The proponent believes that the mitigation measures proposed will minimise pest plant, vermin and litter problems.

2.3.4 Noise

The proponent has stated in the EIS (Section 10.8) that all requirements of the *Environment Protection Act 1993* relating to noise control and emissions will be met. In response to public submissions, the Response document (Section 9.3) provides details of studies carried out to determine existing noise levels, predicted levels and rationale for using industrial standards in a rural region. The findings are discussed further in Section 3.5 of this Report.

2.3.5 Rehabilitation

The balefill would be progressively rehabilitated as each cell is completed. This approach would allow for early closure of the site before the predicted date, without the need for major large scale rehabilitation. Chapter 11 of the EIS and Sections 2.2.6 and 10.10 of the Response document discuss this.

2.4 REGULATIONS, GOVERNMENT POLICIES AND PLANNING STRATEGY

This proposal is subject to the requirements of the Major Developments and Projects section of the *Development Act 1993* as outlined previously. The proponent, if development approval is granted, will then be required to negotiate the terms of an EPA waste licence for the ongoing operation of the site. These licences are issued and reviewed by the EPA at the end of each 12 month period. The proponent has adequately outlined the requirements under the *Environment Protection Act 1993* in Section 1.10 of the EIS.

The South Australian waste management strategy discussion paper titled "Options for an Integrated Waste Management Strategy for the Adelaide Metropolitan Area: 2015 and Beyond" (EPA, 1995) was not prescriptive on site selection for waste sites but did indicate that current landfill capacity will be filled in the next 10 years or so and that alternative sites will need to be developed. It also indicated a preference for larger, well operated sites close to but not necessarily in the metropolitan area. The IWS solid waste balefill proposal would appear to meet these principles.

In line with the objectives of the Integrated Waste Strategy for Metropolitan Adelaide, 1996-2015, EPA, June 1996 (IWSMA) an interdepartmental government committee, the Waste Management Infrastructure Steering Committee, was established late in 1996 to consider the longer term waste management infrastructure needs of Adelaide. The committee has not concluded its deliberations.

Planning Strategy

The Planning Strategy for South Australia is produced by the Premier of South Australia. It is a blueprint for the type of development that the South Australian Government wishes to promote in order to achieve economic, social and environmental goals. The effects of the proposal should be consistent with the provisions of the Planning Strategy, or the extent to which they are inconsistent outlined. This may be taken into account in assessment and decisions on Major Developments or Projects. The Strategy is divided into 2 parts, one for metropolitan Adelaide and one for country South Australia. The Planning Strategy Volume 2 Country, 1994 contained little of specific relevance to this proposal. Notwithstanding, there were statements in regard to protection of the environment and public health and safety. The Country Strategy was reviewed and amended in 1996. The Planning Strategy Volume 2 Country, August 1996 now applies.

The Environment and Resources, Community Health and Resources section of the Strategy (August 1996) indicates that "Storage, collection, transport and disposal of waste requires high standards to safeguard public health and safety and minimise environmental impact". Recycling and re use of waste are also strongly encouraged.

Under the same Environment and Resources section, strategy number 14 is relevant and is outlined as follows:

"14. Locate waste facilities in an orderly and rational manner.

a. Minimise the impact of waste operations on public and environmental health and safety.
b. Encourage, promote and coordinate efforts to improve efficiencies and economies of scale in solid waste management.
c. Ensure the protection of the community from liabilities arising from poor waste management practices by upgrading existing practices.
d. Minimise the contribution of food and other putrescible waste to the solid waste stream."

Strategy 13 on Pollution in the Water Resources section of the Strategy is also relevant to the proposal under consideration and states:

"13. Protect water catchment and storage areas from poor land use and management practices.

a. Provide incentives and information on managing pollution at source.
b. Regulate waste disposal and management of polluting activities through codes of practice, licences and guidelines.
c. Provide farm management advice and develop skills to reduce pollution potential from dryland farming activities, minimise the impact of land clearing and dryland salinity and, where possible, increase farm returns.
d. Identify sources of pollution for each region, catchment and ground water basin.
e. Protect underground water supplies from overuse and pollution.
f. Establish regional water quality standards for waste disposal and reuse.
g. Develop, monitor and update pollution management plans."

The Outer Metropolitan Adelaide (Northern Outer Metro Strategies) makes specific mention to the location of waste disposal proposals.

"identify appropriate remote areas within the Mallala district suitable for the location of specialised industries such as waste disposal, stock or slaughter yards and tanneries."

There is also mention of this type of development in the Manufacturing and Mining section of the Outer Metropolitan Adelaide portion of the Country Strategy:

"Advantages also work in the western parts of the region, for the attraction of specialised industries such as waste disposal, stock or slaughter yards. The strategic location and comparative ease of access provides a serious option for accommodating such activities."

2.5 CONSEQUENCES OF NOT PROCEEDING AND ALTERNATIVE SITES

The proponent states (EIS, Section 12.5.7) that not proceeding with this proposal will necessitate the development of alternative methods for treating a large part of Adelaide's waste. Six alternatives are cited and for various technical and economic reasons dismissed.

In response to questions raised in Public Submissions regarding site selection criteria and rationale used in selecting this site, the proponent has provided in the Response document (Section 3.2) a discussion clarifying the methodology and criteria used. The proponent considers that the land is:

- the most appropriate zone in the district for the kind of use proposed;
- within a generally sparsely settled locality;
- of adequate size to enable separation from other sensitive uses;
- in very poor condition for any general farming activities, having been used for mining and other activities with no significant input into rehabilitation;
- characterised by remnant small areas of native vegetation which can be conserved and reinforced thus encouraging native fauna;
- readily accessible from main roads without passage through densely populated areas;
- capable of being developed and planted to have little visual impact from the surrounding properties or public areas; and able to be developed having proper regard to heritage issues.

3. SOCIAL AND ECONOMIC ISSUES AND IMPACTS

3.1 ZONING AND LAND USE

3.1.1 Zoning

The proposed solid waste balefill site is located within a General Farming zone in the Development Plan for the District Council of Mallala.

The District Council of Mallala produced a Plan Amendment Report, which obtained interim control on 22 August, 1996 (authorised on 1 May, 1997) that made all forms of Waste Transfer Depots or Dumps non complying in this zone, regardless of the type of material.

The proposal, whilst not conforming with some of the objectives and principles of development control for the zone, is not considered to be seriously at variance with the Development Plan current at the time of lodgement of the proposal in 1994.

The most relevant Development Plan policies (Plan dated 7/10/93) are as follows:

> "Region Wide - Rural Development
>
> Principle of Development Control No 91
>
> Land which is particularly suitable for agriculture should be used or remain available to be used, for primary production, unless it is designated for township extension, rural living, or is required for public purposes or for other uses consistent with the objectives for the zone or policy area."

It appears that the subject land is not particularly suitable for agriculture in its existing state and not highly valued for the majority of rural production pursuits.

> "Region Wide - Protection of Physical and Economic Resources"

As a consequence of the sites proximity to a coastal area the following principle is worthy of consideration.

> "Principle of Development Control 145
>
> Development outside of urban zones should not take place if there is the potential for significant conflict with likely development which benefits the wider community based on any of the special economic or physical resources of coastal areas such as:
>
> Tourist attractions
> Harbour and Jetty Sites
> Aquaculture Sites
> Marina Sites
> Mineral Deposits of State or National importance."

It is not envisaged the proposal will significantly conflict with any likely developments of wider community benefit. The site is a sufficient distance from the coast to not conflict with the majority of developments listed. The Department of Road Transport (DoT) operated a borrow pit in the vicinity. The proponents have stated that the DoT have advised that it "has now concluded its mining activities and the resources from this land taken".

There are a number of mining leases adjacent to the locality for the extraction of salt and it is important to ensure leachates do not enter the water table as this could effect proposed salt extraction operations. The method of operation and control measure indicated in the EIS, Response document and Clarification of Issues document are such that leachates should not be a problem.

> "General Farming Zone
>
> Objectives:
>
> 1. Maintenance of general farming activities and land use on large property holding
> 2. Reinforcement of the existing open rural character of the area
> 3. Preservation of features of scenic or environmental significance
> 4. Recognition of the flooding potential of the Light River, Gawler River and Templers Creek."

The Development Plan goes on to explain that "the characteristics of the district favour the continuance of cropping and grazing uses and it is desirable not only that they remain, but also that good land management practices be encouraged to control proclaimed pest plants, vermin and soil erosion and that revegetation of certain areas be undertaken."

Whilst this proposal reduces the area available for cropping and grazing uses on the subject land, if managed as stated, soil erosion will be halted and revegetation of a denuded area will be undertaken.

> "Principal of Development Control 17
>
> The following kinds of Development are prohibited in the General Farming Zone:
> "....."
> Disposal, treatment and/or storage of contaminated soil and waste referred to in Schedule 2 of the Waste Management Regulations 1988
> .....
> Waste Transfer Depot or Dump (comprising the handling or storage of hazardous waste)"

It is not proposed to treat, store or handle contaminated soil or hazardous waste. Therefore, at the time of development application lodgement the proposal was not considered prohibited within the zone.

A plan amendment came into effect on 22 August 96 (interim control - authorised 1 June, 1997) which removed the handling or storage of hazardous waste statement. In effect this means that the proposal is a non complying form of development pursuant to the relevant Development Plan in force now. The Principles of Development Control have remained almost identical although in places the numbering has changed.

3.1.2 Current Land Use

The land appears to have been heavily grazed and the eastern portion contains a disused borrow pit. The borrow pit was mined by the DoT for road making material.

The major adjacent land uses are grazing, intensive animal keeping and mining tenements (Penrice Soda). A residential dwelling exists on the subject land which would be used as the caretakers residence.

There is a residential dwelling quite close to the south eastern boundary. The proponent has stated that "fill" will not be placed within 520m from the dwelling. The EIS (Section 2.7) describes the adjacent land use.

The general character of the land is quite bare and denuded, with remnant pockets of native vegetation evident.

3.1.3 Implications of Proposed Land Use Change

The proposed change of use will alienate the land for grazing or cropping which is the major use envisaged in the Development Plan. The long term gains to the community in terms of replanting indigenous species, creation of native fauna habitat and improvement in soil stability should offset the loss of grazing land. The loss of this parcel of grazing land is not expected to affect the agricultural viability of the region as a whole.

The impact a landfill site could have on the adjacent mineral leases (salt extraction) is an important consideration, however the EIS and Response document address the issue of leachates and conclude it is unlikely that there would be a detrimental impact on this adjacent land use. While Mines and Energy SA (MESA) has advised that "… no adverse effects on the groundwater resources of the area will result from the proposed landfill operation", Penrice Soda expressed concerns regarding potential leachate contamination of its future evaporation ponds. Leachates are discussed in Section 4.7 of this Report.

Whilst the issue of a buffer between the operations and the closest existing dwellings has been addressed, a 500m buffer round the operations has not been provided within the subject land. This could have an impact on the future division of adjoining land and siting of dwellings. Regardless of where an applicant wishes to construct a dwelling it is likely that a 500m separation of new dwellings from the boundary of the subject land could be imposed pursuant to the *Development Act 1993*. Any division of land would have to be of sufficient size to ensure a dwelling could be sited 500m from the balefill. It is acknowledged that due to the size of existing adjacent parcels this is not a major problem and it is unlikely that the adjacent land will be required for denser division in the foreseeable future, however, it is a minor restriction on adjoining landholders. Based on existing land ownership, small amounts of land belonging to seven landowners would be affected.

3.1.4 Listed Wastes

Neither the EIS or Response document envisage the receipt of Listed Wastes as set out in Schedule 1, Part B of the *Environment Protection Act 1993*. In the event the proponent should, at some later stage, wish to handle and receive listed wastes, further development authorisation would be required.

3.2 VISUAL IMPACT

The visual impact of the proposed landfill has been raised as a significant community concern, for both the operational phase and following final closure of the site. Generally, this type of land-use will impose the following features on the landscape which can reduce the visual amenity of an area if not adequately mitigated:

- built structures (eg. office, amenity building, rainwater/fuel tanks and gatehouse/weighbridge);
- infrastructure (eg. fencing, signs, internal roads and car parking);
- earthworks, screen mound and stockpiles;
- machinery (eg. bulldozers, excavator, graders, impact rollers and articulated forklift);
- vehicles (eg. cars, water tanker and trucks);
- working face and final landforms.

3.2.1 Existing

The site is located on the gently sloping coastal plain and has been described as falling gently to the west, towards the coast. The highest point on the site is 14m AHD, which is equivalent to the elevation of Port Wakefield Road to the immediate east. The site is only partially visible from Port Wakefield Road as roadside vegetation, several stands of remnant native vegetation and the slightly undulating topography currently screen it to some degree. Views from along Prime Beach Road (Response Figs. 8.5 and 8.6) are only partially screened by native vegetation. Stands of native vegetation along the southern site boundary help screen views from surrounding land uses in that direction. An existing house, which would be used as the managers residence, is currently screened by well developed plantings.

The eastern portion of the site has previously been excavated for road building materials and, while partially rehabilitated (ie. topsoil replaced but no significant re-establishment of vegetation cover), does not match natural ground levels. The land in this area has also been used for illegal off-road vehicle use which, along with the degraded nature of the land (resulting from agricultural activities) surrounding the sheds in Section 305, further reduces the visual attractiveness of the site.

3.2.2 Operational Phase

The EIS (Section 4.1) and Response document (Sections 3.7 & 3.8) propose to mitigate the visual impact of the site using a combination of existing screening and boundary plantings. Existing stands of native vegetation would be retained as a natural screen and indigenous species would be selected for revegetation, using a combination of seeding and tube stock planting. A proposed buffer zone (50m minimum width) would be established along the site boundary, comprising a 25m wide vegetation screen (5m wide strip of shrubs; 20m wide strip of trees), fire break, surface water drains and perimeter road. In addition, the proponent now intends to construct a 3m high earthen mound, where required, (ie NE & E sides), as part of the buffer, upon which trees/shrubs would be established as part of the proposed vegetation screen (Figure 3).

In general, the proponent intends to begin the establishment of screen plantings prior to site works commencing (ie. approximately 2 years in advance) to allow vegetation to grow and to provide a limited buffer before the site becomes operational. Given the low level of soil moisture availability experienced in the area, screen plantings can be expected to progressively develop (depending on climatic conditions) to a suitable height and density to reduce the long-term visual impact of the landfill (ie. tree species to reach an average height of 3m within 5 years and 6-8m within 10 yrs; shrub species to an average height of 2-3m within 5 yrs and senescent in 10-15 yrs). In addition, the proposed 3m high earthen mound would provide an immediate visual screen of balefill operations during the filling of early cells and would considerably improve the overall screening value of plantings. It is expected that vegetation would be established or reinforced around the entire perimeter of the site to provide an adequate screen and buffer zone between neighbouring properties, surrounding viewpoints and landfill operations.

The screening (and ecological) value of the stands of existing native vegetation within the site should be improved by supplementary plantings and/or encouraging natural regeneration, especially of understorey species. Other existing stands in adjoining areas should be linked by suitable wildlife corridors wherever possible. Ideally, strategies for the management of native vegetation on site should be extended to remnant stands on adjoining properties and along roadside verges, in co-ordination with landowners and the D.C. Mallala. Section 4.3 and Appendix B of this Report contain further details on revegetation aspects.

Whilst not solely under the control of the proponent, to provide additional screening and wildlife habitat it is recommended the following options should be investigated:

- revegetation of the road reserve along Prime Beach Road (in conjunction with the DC Mallala and the community);
- revegetation of the road reserve along Port Wakefield to further reduce views from the eastern direction (in conjunction with the DoT);
- plantings on private property along fence lines adjoining the site (in conjunction with landowners and the local community).

The use of highly saline borewater for 'damping down' (dust control) could result in the contamination of topsoil and covering materials with salt and significantly reduce the success of revegetation, therefore, it is recommended that damping down using borewater should be restricted to within the landfill area. This saline water could then be collected by the leachate collection system.

It is also recommended that alternative measures for controlling erosion (eg. hydro mulch seeding of the earthen buffer mound, establishing native grass cover on stockpiles and areas of bare earth, using rubble for internal roads etc) be investigated and adopted where practicable.

Buffer Zone/Perimeter Screen

In accordance with EPA criteria the Response document (Figure 2.8) now proposes to establish greater buffer distances, which are further discussed in Section 3.7 of this assessment.

Whilst the Response document (Section 2.2.6) states that landscaping of buffers will be completed before earthworks for each stage are commenced, due to the potentially slow establishment and growth conditions of the site, it is considered that all perimeter plantings should be started as early as possible to achieve maximum amelioration of visual impacts and establishment of habitat. In particular, the establishment of plantings along Prime Beach Road is not proposed to commence until the completion of Stages 4 - 6 (Response Figure 2.10), however, it is recommended that plantings along the north-western boundaries should also commence immediately. Boundary plantings should also be extended along the north-eastern section that adjoins a stand of remnant native vegetation.

Adequate screening could be established using a suitable mix of endemic species and careful site preparation and greater long-term screening can be achieved progressively by establishing vegetation cover up the final landform slope rather than relying on an immediate visual barrier provided by screen plantings at the base of the mound. Fast growing colonising species, such as Acacias, are ideal for achieving an immediate screen, whilst providing nitrogen to the soil, shelter for plantings and erosion control. In addition, options for establishing multi-use plantings (eg. fast growing, irrigated sterile tube plantings of hardwood Eucalypt species for timber, native shrub species for the cut flower or seed market etc.) should be investigated and adopted, where suitable, to either supplement proposed plantings on site or to provide an additional buffer on adjoining properties. This type of activity would be ideally conducted in co-operation with local landowners, and in consultation with the proposed Local Community Consultation Committee (LCCC).

The proposed location of a fire break and external drainage channel between the perimeter fence and the vegetation screen is likely to significantly reduce the wildlife corridor/habitat value of the proposed plantings. In response to concerns expressed by the Native Vegetation Council, to minimise or avoid clearance of remnant native vegetation both firebreaks and drainage swales for surface water external to the site should follow the internal edge of the remnant vegetation rather than the property boundary. In the event that drainage channels are required to be located close to the site boundary, they should be redesigned to form low-lying wetland/saltmarsh communities as part of the vegetated screen.

The EIS (Section 4.1.3) proposes to establish a cover of grass or groundcover species on finished cells, whilst Sections 4.1.4 to 4.1.7 of the EIS present the types of species and methodologies that would be adopted for revegetation. Whilst many of the species are endemic to the area, others are either introduced or considered unsuitable, therefore, it is recommended that revegetation aspects (ie. final species selection, screen density and composition and methodology) be determined during the preparation of a detailed Vegetation Management and Revegetation Plan as part of the LEMP (Assessment Report, Section 4.3 and Appendix B for further details).

Built Structures and Infrastructure Requirements

To improve the visual appearance of the main access point to the site, the proponent intends to develop an architecturally designed entrance way and associated infrastructure to present a high standard image, similar to other modern landfills in Australia.

The Response document (Figure 4.1) indicates the entrance facilities would be screened by a combination of existing vegetation and a 20m wide landscaped buffer zone around the section boundary. The car parking area, workshop and staff amenity building should be further screened by amenity plantings around their boundaries. A 1.5m high post and wire perimeter fence (vermin proof wire to a height of 1m; two strands of barbed wire above) is proposed to be erected around the site boundary, which would be highly visible from outside views unless screened by existing vegetation. The whole length of the internal access road is proposed to be sealed, which will continue up to the first balefill stages. It is expected that all other internal haul roads would be constructed with crushed rock.

To reduce the visual impact it is recommended that all built structures be immediately screened using suitable amenity plantings in accordance with a Vegetation Management and Revegetation Plan, the perimeter fence be screened by suitable plantings where adequate natural screening is not provided, and all internal roads should be screened by plantings where practicable.

Earthworks, Screen Mounding and Stockpiles

Earthwork activities are expected to be visible during the initial stages of construction, with the level of visual impact would be determined by the type of activity, the progress of boundary plantings and the level of existing screening, however, the 3m high buffer mound would provide an immediate effective screen for most activities. The earthen mound would be highly visible during the initial stages until screened by plantings. Stockpiles also have the potential to be highly visible, therefore, it is recommended they be located in areas that are adequately screened (ie. near areas of existing vegetation).

The EIS (Section 9) states that stockpiles and internal roads will be sprayed and dampened for dust control, however if saline water is used, this would be detrimental to successful revegetation (and the effectiveness of screening measures) and may exacerbate soil salinity. It is recommended, therefore, that the use of saline water for erosion control (esp. on the buffer mound) should be avoided and that alternative measures be investigated and adopted. For example, construction of the mound and the establishment of vegetation cover could be timed to ensure the exposure of bare earth is minimised. Alternatively, a “spray-on” type of mulch/seed mix could be applied to the mound to provide both erosion control and vegetation cover as a method of “best practice” management. Follow-up spraying would be required to cover any unsatisfactory or eroded areas.

Working face

The base of each balefill stage would be excavated to well below the ground surface level and initial operations would not be visible. As cells become completed the outer wall of each stage

would be constructed to form an earthen mound, which would then provide adequate screening of above-ground operations. The Response document (Section 8.1) proposes to place a 1.8m high chain wire litter control fence around the active waste cell. Thus, it is expected that the fence, balefill machinery and working face would be adequately screened from near views by the outer wall of each stage and from far views by the screen mound and boundary plantings.

3.2.3 Rehabilitation

The final landforms are proposed to be developed progressively as each stage is filled and rehabilitated. The proponent has modified the original final landform shape from three long, almost linear mounds to a series of eight flat mounds staged from east to west, which are designed to maintain as much of the existing surface water drainage patterns between stages as possible and to break up the final profile of the site**.** Final heights are proposed to reach a maximum or peak crest level of 23m AHD. which is 9m above the level of Port Wakefield Road. The exterior slopes will have a relatively flat slope of 1 vertical in 5 horizontal, which will flatten out to a minimum slope of 3% at the top of the slope to form a rounded profile and to maintain drainage.

The Response document (Section 3.7) proposes only to vegetate the visible "shoulder point" of the final mound (due to existing screening provided by interposing vegetation and local topography) to screen views from Port Wakefield Road, however, this is considered insufficient. Consideration should also be given to near views and the amenity, habitat, and erosion control value of vegetation cover, therefore, it is recommended that the entire landform be planted with appropriate types of vegetation. Refer to Section 4.3 of this Report for further details on revegetation aspects. Satisfactory long-term screening would be achieved progressively by establishing vegetation cover up the final landform slope, supplemented by the visual barrier provided by existing native vegetation and screen plantings established between the base of the mound and the site boundary.

The requirements in the post closure phase will depend on the intended end use of the site. The EIS (Section 11.2) states the end use of the site will be open grazing and cropping, however, care would need to be taken to avoid effects detrimental to the maintenance of vegetation cover and the control of erosion. As recommended by the Native Vegetation Council, a stock proof fence could be erected and maintained around the boundaries of native vegetation to ensure the exclusion of grazing, in the event stock are allowed access to the site. The Response document (Section 2.2.8) states the determination of interim and post closure land uses of the site needs to be undertaken in association with the Local Community Consultation Committee. This matter would be dealt with in the LEMP.

Visual impact after site rehabilitation

Landfill operations are proposed to have a lifespan of between 60 and 80 years, during which time vegetated buffer zones would have become well established and attained a height that is expected to provide adequate screening of landfill operations.

In conclusion, the visual impact of the proposed landfill would be expected to change over time. Initially, the creation of the screen mound and the outer slope of each active stage would gradually establish prominent features on the landscape that, whilst screened to a large degree by vegetation, would be highly visible due to their large scale and slightly elevated height (ie. compared to relatively flat nature of the local topography). They would also remain obvious because of their green cover of native vegetation, especially during times of the year when the surrounding country has 'browned off'.

The completed site is expected to have the appearance of a series of large vegetated mounds within a largely cleared flat landscape. Progressive and final revegetation of the landfill and the establishment of screen plantings around the site perimeter, and possibly adjoining roadside reserves, should adequately mitigate the visual impact of the site, especially from Pt. Wakefield Road and Prime Beach Road.

3.3 WASTE TRANSPORT

3.3.1 Vehicle Description

The EIS (Section 12.3.6) states wastes are likely to be delivered in B-Double trucks (30 tonnes), in the case of baled wastes from transfer stations, or loads of 20 tonnes in the case of demolition wastes. Vehicles for waste transport would be licensed by the EPA.

3.3.2 Truck Access Route

Following the release of the EIS, a number of respondents raised concerns over access to the site and impacts on neighbouring residents.

The proponent has indicated (EIS, Section 12.3.6) that nearly all of the baled waste would be expected to arrive from the south ie. from the IWS Wingfield Resource Recovery and Transfer Facility or other baling operations likely to be established in the metro area. A "controlled access" road already exists along the eastern boundary of the site, therefore no impact on local roads is anticipated.

The EIS (Section 12.3.6) predicts a daily average of 25 trucks of various configuration entering and leaving the site. Table 3.1 of the EIS provided vehicle numbers and classification based on 1993 data. In Section 9.5.1 of the Response document, 1995 data is used and a more detailed analysis provided. The proponent has estimated that most cover material would be available on site (EIS, Section 7.6, Response, Section 4.10). Importation of cover material is, therefore, not expected to significantly increase truck numbers to the site.

The proponent has assumed that all vehicles would enter the site from the south and exit south along Port Wakefield Road.

The proponent believes that the existing opening from Port Wakefield Road to the service road, with modifications shown in the EIS (Figure 6.2), would be adequate for vehicular movements. The Department of Transport (DoT) in its submission concurs with this view but also states that detailed design of the opening and associated left turn deceleration lane, as well as the construction, should be completed to the satisfaction of DoT, with all costs being borne by the developer. This approach would meet government requirements.

The Country Fire Service (CFS) have expressed concern that the potential for accidents that they would be expected to attend occurring as a result of heavy vehicles crossing Port Wakefield Road, has not been addressed in the EIS.

To lessen dust the internal road leading to the first balefill stage would be sealed (Response, Section 9.5.3).

In conclusion the proponent believes that, given the numbers of vehicles involved (an increase of 4%) the proposal does not create an additional traffic hazard along Port Wakefield Road or interfere with existing local traffic (Response, Section 9.5.1).

3.3.3 Washdown Area

The proponent has provided a wheel washdown area for vehicles at the entrance to the landfill. Neither the EIS nor the Response document provide sufficient technical or operational detail to demonstrate how this would operate, on what criteria washdown would be required, and what provisions for container or truck tray cleaning would be made. All washdown waste waters would be directed to the leachate storage area (Response, Section 4.9).

Full working plans of this aspect of the proposal need to be provided in the Landfill Environmental Management Plan (LEMP) prior to a licence being granted by the EPA.

3.4 INFRASTRUCTURE REQUIREMENTS

For operational purposes the site would require power, water and sewage facilities.

An existing house on site would become the site manager's residence and additional buildings including a cashier's hut and office, an amenities building, workshop and weighbridge, would be constructed. A septic system, to comply with the South Australian Health Commission's standards would be installed (EIS, Section 4.2).

Electricity is already supplied to the existing building on site and upgrading of services, as required, would be arranged with ETSA Corporation. An existing bore has sufficient capacity to provide water for dust control and fire fighting. Reticulated water to the existing buildings would also have to provide water for irrigation systems for new plantings as the bore water is too saline. A telephone service is connected to the property (EIS, Section 3.20).

While the proponent has stated in the EIS (Section 4.4.1) that a 2m high chain wire security fence is to be constructed in two stages, the Response document (Section 8.1) refers to a 1.5m high rural, stock and vermin proof fence. This fence is not expected to create a visual barrier to the open nature of the surroundings. A 1.8 m high chain wire (litter control) fence is to be placed around the active waste cell. No adverse impacts are anticipated from this construction.

The provision of these facilities should not create adverse environmental impacts.

3.5 NOISE

The EIS (Section 10.8 and 12.3.2) and Response document (Section 9.3) outline the noise impacts anticipated from the proposal.

The proponent (EIS, Section 10.8) has made a commitment to comply with the requirements of the *Environment Protection Act 1993* and subsequent regulations and policies, in particular the Industrial Noise (Schedule 2) and Machine Noise policies (1994). There is also a commitment to quarterly monitoring of the site and adjacent areas.

Following concerns raised in submissions on background noise levels, predicted noise levels, impacts on residents and mitigation measures, the proponent carried out additional studies (Response, Section 9.3). Measurements presented are correlated to meteorological conditions at the time of measurement.

The Office of Environment Protection is of the opinion that "the predicted noise levels would comply with the requirements of the *Environment Protection (Industrial Noise) Policy* (the "Noise Policy") between the hours of 7 am and 10 pm for an area described as predominantly rural, and that "the noise emissions would therefore be considered acceptable during those hours". However, it is stated that "the noise would not be acceptable before 7 am or after 10 pm". The EPA will require compliance with the provisions of the Environment Protection (Industrial Noise) Policy relating to rural areas.

This noise assessment is based on the proximity of proposed operating equipment to existing dwellings. Once the first two stages of the balefill are completed and equipment moves further away and is screened to some extent by the completed stages, noise levels would decrease. It is, however, possible that other dwellings may be established in the vicinity during the operational life of the balefill and constraints on operating hours appropriate for the first two stages may not be appropriate later.

There is a slight chance that during cell preparation some blasting may need to take place to fracture the calcrete layer. Any blasting must be carried out in compliance with Australian Standard 2187.

3.6 LITTER

All existing Adelaide landfill operations have had air borne litter problems, with paper and plastic supermarket bags being the chief offenders. Sections 10.6 and 12.3.4 of the EIS discuss potential problems and methods of control. Section 9.2.2 of the Response document addresses public concerns regarding litter.

As a balefill operation the proponent anticipates negligible litter to be produced.

The EIS (Section 10.6) indicates that no loose waste material would be received. The proponent further states that unbaled waste (presumably demolition waste) likely to produce litter will be covered immediately. Further control is to be obtained from a 3m high bund around each cell.

The Response document (Section 9.2.2) further states that demolition and industrial waste would have been through a resource recovery facility resulting in the minimisation of litter. A 1.8m high relocatable wire fence would be placed around each cell which would help contain windblown litter. Further, the proponent makes a commitment to collecting litter from the boundary fence and neighbouring properties as and when required.

This approach meets the requirements of both the Department for Transport, Urban Planning and the Arts (DTUPA) and the OEP in relation to litter minimisation and management. The EPA considers that shredding and baling provides a means of reducing potential litter problems (Assessment Report, Appendix A).

3.7 BUFFERS

The proponent, when preparing the Response document, has referred to the EPA Draft Buffer Guidelines issued in December 1996 which require a minimum separation distance of 500m from landfill to the nearest residence. Subsequently these were superseded by the Interim Criteria which adopt a 500m buffer zone within the depot between the discharged waste and the property boundary. The Interim Criteria provide that " the buffer zone within the depot between the discharges waste and the property boundary should be at least 500m. A lesser buffer zone within the depot may be approved by the EPA if justified by the compatibility of adjacent landuse".

There have been three versions of the buffer guideline document, none of which have any legal status.

The proponent received many comments about buffer zones during the public display period, resulting in a revision of the site layout. The Response document (Section 3.4 and Figure 4.3) provides new buffer distances. The proponent believes that this approach complies with the EPA Interim Criteria for major landfill depots. Further, the proponent states that as the proposal is for a balefill as opposed to a conventional landfill an additional "....attenuation of impacts..." will occur.

The proposal has allowed for 520m buffers from the two nearest residences and a 500m buffer to the Penrice mineral lease area, with a minimum of 50m buffers along other boundaries. In the event that a property owner wishes to develop closer to the common boundary, then the buffer distance will be reduced accordingly. However, such development would be undertaken with

knowledge of the presence and impact of the landfill activity. These issues have been discussed further in Sections 3.1.3 and 3.2.2 of this Report.

3.8 AIR QUALITY

Gas and odour generation are part of the waste decomposition process. In the public submissions many respondents expressed concerns that there would be a deterioration in air quality at nearby residences and townships including Dublin, Port Parham, Thompson Beach and Webb Beach. The proponent is of the opinion (Response, Section 9.2 and 9.2.1) that buffer distances and the distances between the balefill and townships are sufficient to "...maintain a healthy living environment".

The proponent (EIS, Section 12.3.3) proposes to control and minimise odour generation by:

- regular covering of waste with material identified as being particularly odorous buried immediately;
- baling and shredding of waste;
- monitoring and inspection of cover materials for cracks;
- maintaining moisture content in surface materials;
- pro-active Landfill Gas (LFG) management system;
- management and monitoring of leachate.

The proponent must comply with provisions of the *Environment Protection Act 1993* with respect to air quality (including odours). The EPA would determine specific requirements during licensing.

The use of saline ground water for dust control is likely to result in salinisation of areas of the site and affect areas of revegetation by spray drift. Staff working at the site should be aware of these problems and work on suitable days.

3.9 FIRE RISK AND PREVENTION

Section 7.4 of the EIS deals with fire management and provides a 4m firebreak between the boundary fence and the perimeter screen plantings. A 6m wide access road is provided adjacent to the deposition area. The Response document, with the revised cell structure, does not discuss fire issues again, as the proposed cell system would minimise fire hazard. The Response document (Section 7.5) states that landfill gas monitoring would, by monitoring carbon monoxide levels, detect if any underground fires exist. A perimeter access road is indicated between the internal surface and external surface water drains (Response, Figure 2.6) and it is assumed this will be maintained to a standard required for emergency access to a cell. Further, Figure 2.8 of the Response document shows a 4m wide external fire break and an 8m wide perimeter road.

A condition of licensing would be that adequate fire safety precautions and control measures, including access tracks, are provided within the balefill complex. These can be addressed in the Landfill Environment Management Program (LEMP).

3.10 HOURS OF OPERATION

Depot operating hours are proposed to be 6.00 am to 7.30 pm seven days per week (daylight hours only) with wastes being accepted from 7.00 am to 7.00 pm only (EIS, Section 6.2 and Response, Section 4.6).

The proponent is of the view (IWS pers comm. September 1997) that to provide an essential service to the community and adequately service the waste disposal needs of the metropolitan area a 7 day operation would be required. The argument is further supported by the fact that baled waste can not be stored at the IWS Baling Facility at Wingfield for longer than 24 hours.

The hours of operation would be determined in the licensing process should development consent be granted.

Local residents indicated in their submissions that weekend operation (particularly Sunday) would be an unacceptable impact on them.

3.11 HERITAGE

3.11.1 Aboriginal Heritage

The former Department of State Aboriginal Affairs advised that there is no indication of either sites or objects of significance having been identified at the subject site, however there are known to be Aboriginal sites in the general area.

An archaeological survey as part of a study by the Kaurna Aboriginal Heritage Committee has been completed for the whole site. While nothing was found of significance some blowouts incorporated within a dune formation were identified for monitoring during the excavation of material from those parts of the site.

Operators and construction personnel should be made aware of the identified monitoring areas and should be aware of and comply with the requirements of the *Aboriginal Heritage Act 1988.* Any burial sites, skeletal material or significant discovery is to be reported immediately to the Aboriginal Heritage Branch of the Department of the Environment, Heritage and Aboriginal Affairs (DEHAA).

3.11.2 Non-Aboriginal Heritage

There are no items within the site that have other heritage significance.

3.12 ECONOMIC

IWS Pty Ltd have indicated that the estimated total annual cost of the Wingfield and Mallala operations is $5 million. The estimated bulk haulage cost from Wingfield to Mallala for baled waste is $0.12 per tonne/kilometre which is lower than the normal bulk haulage rate of $0.15 per tonne/kilometre for loose waste. Balefill costs are less because of the high densities achieved in a bale and, therefore, greater transport economies.

The investment of an estimated $10 million, the employment of 20 personnel together with the proposed power generation using landfill gas (LFG) and the creation of a Community Trust Fund (Clarification of Issues, Section 5) are all considered, by the proponent, to have a positive economic impact on the State.

The direct economic benefit to the local community has not been identified other than to state that the proposal will provide employment opportunities and use of local skills and services.

There would be a significant, although unquantified, short term investment generated through the construction of the Wingfield recycling, shredding and baling facility and establishment of the Mallala balefill site.

Other waste treatment alternatives, except for conventional landfilling and enclosed vessel digestion and composting, are not economically viable in South Australia. Balefill has the advantage in that enclosed vessel digestion and composting does not have a proven track record in Australia and conventional landfill does not have the advantage of baled waste. Loose waste needs more extensive controls with respect to visual amenity, litter, dust and odour.

IWS have proposed to commit themselves to an industry standard financial package in the form of insurance which would be provided as part of the Landfill Environmental Management Plan (LEMP) for the purpose of management and potential environmental remediation works (pre and post closure) and would require approval from the EPA. The fund levels would change depending on how the facility develops and as practice and procedures change so would the need for funds. Financial consideration would need to change according to need and risks.

The funds allocated would cover the liability control for the current operation together with ongoing monitoring and post closure program that would be required for each balefill stage. The established principle for prudent cover would be in two parts, a public liability policy and a financial package to be progressively established at the site to be developed to cover any cost of remediation works.

The site and operation would be covered by a public liability insurance with up to a maximum of $5 million cover.

The financial aspects discussed above would be addressed by the EPA under licensing processes.

Property values

The extent of impact on dollar value of any residential property is difficult to determine. The proposal may influence land prices. The EIS (Section 12.5.6) estimates that the worst case scenario would result in a reduction of property value by 10-15%.

Eleven public submissions raised the issue of property devaluation. The proponent has in the Response document (Section 9.8) again acknowledged the potential of the proposal to impact on land values, which it considers a reasonable occurrence. Further, the proponent is of the view that other proposals, of a rural nature, could also affect property values.

The proponent's longer term view is that the amenity of the site will be enhanced by extensive revegetation and maintaining only a small working/tipping area exposed at any one time.

Agricultural activities

A number of submissions expressed concern about the impacts on surrounding agricultural activities. In particular the quarantine status of poultry and broiler sheds, and the risk of disease from avifauna and mice. The Dublin and Districts Ratepayers Association Inc and the DC of Mallala claim that the region and State would suffer major economic loss through the establishment of the balefill, although no corroborative evidence has been provided.

It has been ascertained that animal health (Assessment Report, Section 3.9.2) is not at risk from this proposal, therefore, no negative economic effects on the poultry, piggery, cattle or sheep industries in the immediate area are anticipated.

It should be noted that a chicken processing plant, and food warehouse are sited within 1km of the Wingfield landfills and no problems have been identified.

The impact on farming land is likely to be minimal as the landfill should have no impact on the ability to farm the adjoining land, providing the facility operates within its licence conditions, particularly, in regard to the control of vermin, dust, litter and the management of surface and ground waters.

Livestock Exports

The proximity of the balefill to the Nasser feedlot could create a perceived health risk to the livestock in the feedlot and may make the animals unsaleable in some overseas markets. The body of evidence (Fedorak, 1991) would indicate that there is, on balance, no greater health risk from the balefill than there would be from another intensive livestock activity on the same site.

The concerns expressed to the EPA by the Dublin and Districts Ratepayers Association Inc. regarding the potential for transmission of diseases to animals in the Nasser feedlot with resultant loss of export earnings of $20 million to $30 million, have been followed through by the EDA and DHUD. Consultation with Department of Primary Industries and Natural Resources (DPINR), AQIS and A L Mukairish Aust Pty Ltd (agents for Nasser) have not substantiated the claims made by the Ratepayers Association. The matter is seen only as a "perceived" risk by principals of the exporting company who have asked to be kept fully informed on the proposal (Mukairish pers. comm. Sept. 1997).

4. BIOLOGICAL AND PHYSICAL ISSUES AND IMPACTS

4.1 Biological Environment

The proposed site is located in the Mallala Environmental Association, which is described as an undulating plain with occasional dunes, used for rotation cereal cultivation and livestock grazing (Laut et al, 1977). The proposed site has been extensively cleared of native vegetation that would have provided habitat for native fauna, apart from several small remnant stands of mallee and saltmarsh communities. Agricultural land-uses in the region have significantly modified the natural environment to such an extent that much of the existing habitat is now reduced to isolated stands and roadside verges, with a majority of understorey species being absent due to grazing pressure. The existing fauna in the region now comprise species that are adapted to agricultural landscapes, ie. the more common reptile and bird species.

Whilst not a key determinant in this assessment, the following provides additional detail which should assist promoting successful outcomes particularly in relation to remnant vegetation enhancement and revegetation which depend on good quality planning and preparation at the outset.

4.1.1 Native Vegetation

The EIS (Section 3.15) identified the native vegetation on site as Tall shrub and Open scrub formations dominated by Mallee species, with an Acacia-chenopod understorey. The principal indigenous tree species is *Eucalyptus gracilis*, with *E. dumosa* and scattered clumps of *Melaleuca lanceolata*. Tree cover is described as sparse, with patchy areas of shrubs and groundcover and an understorey that is sparse to non-existent. Most tree species are senescent and no natural regeneration has occurred. Species diversity is low, reflecting geographic location, soil type, past land uses and practices. A saltmarsh-like system, which contains *Halosarcia halocnemoides*, *Threlkeldia diffusa*, *Atriplex paludosa* and other saltmarsh and salt tolerant species and groundcovers, occurs in the south-western corner of the site.

Whilst a species list has been included in the EIS, a scientific description of vegetation communities (ie. structure, cover, abundance, condition etc.) and distribution map for the site have not been provided, therefore, it is recommended that for monitoring purposes they be prepared for inclusion in the Vegetation Management and Revegetation Plan. None of the species listed are considered rare or endangered, however, *Santalum acuminatum* is rated as Uncommon in the Northern Lofty Region and *Pittosporum phylliraeoides* and *Geijera linearifolia* have not been formally rated. According to Kraehenbuehl (pers. comm. 1997) remnant vegetation represents only 6.7% of original cover in the Northern Lofty Region (approximately less than 2% in the general locality).

A vegetation survey of the Mallala District Council area by Pedler and Matheson (1993) identified several species in patches close to the site that contain species which were classed as 'endangered plants' (eg. *Westringia rigida*, *Helipterum sturtianum*, *Pimelea serpyllifolia* and *Scaevola spinescens*). It should be noted that these ratings only apply to the council area and are not official ratings for the State, therefore, they should be used as a guide only.

Thus, whilst the remnant native vegetation on the site is not considered to be significant from a State conservation perspective, it could be threatened on a local scale. This would need to be further examined in preparation of a Vegetation Management and Revegetation Plan

Whilst the proponent does not intend to clear native vegetation, it is uncertain whether this includes low-lying saltmarsh communities, therefore, it is recommended that these areas be protected from further degradation (esp. from any increased inundation) and measures be adopted to improve their ecological value, especially if such areas are to be used for the management of surface water. This can be further addressed in the Vegetation Management and Revegetation Plan.

Existing vegetation (esp. the sensitive root zone) will need to be protected from disturbance during site preparation and landfill operations, therefore, it is recommended that all activities (inc. vehicle movements) avoid remnant stands and individual trees to a minimum distance of 5m (ideally 10m) from the dripline of the canopy edge. Such a buffer should be delineated using clearly visible marker pegs and site operators should be made aware of the need to avoid native vegetation.

In conclusion, the detrimental impacts of the proposal on existing native flora are expected to be minimal, with any disturbance to native vegetation being far outweighed by proposed revegetation and weed control measures.

However, further detailed investigations and the preparation of a Vegetation Management and Revegetation Plan are required to ensure the successful establishment of plantings and the sustainable management of existing communities.

4.1.2 Native Fauna

Pedler and Matheson (1993) consider the fact that there are no large expanses of remnant vegetation anywhere in the district means that only a reduced selection of the native fauna can still exist. The species of mammals, birds and reptiles which remain will be small in number and will represent those which are best able to survive in very open habitat, that cropped and grazing paddocks provide. This is certainly the case for bird species, with those that need an understorey (and its accompanying insect fauna) or leaf litter/rotting wood layer being absent.

Whilst the EIS (Sections 3.16, 3.17, 3.18 & 3.19) provides species lists for avifauna, mammals, amphibians and reptiles, these are sourced from literature and data base surveys, not site surveys. It should be noted that many of the native species listed are, therefore, unlikely to occur on the site due to a lack of preferred habitat. The EIS (Section 12.4.3) recognises that the reduction in native flora has led to a consequent reduction in the number of native faunal species in the area and those remaining are those that have been able to successfully adapt and survive in open habitat. Population densities, especially small mammals, are typically low in similar areas and reptiles are particularly predominant. There are no sites of biological or ecological significance for protected rare/endangered species within or adjacent to the site. The closest sites of significant fauna habitat in the region are considered to be the coastal and marine ecosystems of the Gulf St Vincent, the Clinton Conservation Park and the Dublin Scrub.

In conclusion, the potential impacts on existing native fauna are expected to be minimal, with any disturbance to fauna being far outweighed by the proposed expansion and improvement of available habitat in the area, provided existing stands of native vegetation are sustainably managed, suitable revegetation is successfully undertaken and pest plants and animals (including Silver gulls and Ravens) are adequately controlled.

4.1.3 Impacts on Biological Communities and Ecosystems

Generally, due to previous reductions in species populations resulting from past and present agricultural practices the impacts of the proposal are not expected to detrimentally effect local ecosystems. No significant species of conservation value have been recorded on site. It is expected the proposals for revegetation and the control of introduced plant and animal species will greatly improve habitat in the area and would encourage increased populations, especially avifauna.

From a regional perspective, the proposed landfill may pose a slight risk to coastal and marine ecosystems associated with the Gulf of St. Vincent. In the event that leachate escapes from the groundwater protection system into the underlying and/or unconfined (ie. local) aquifer, there is only a very slight potential for pollutants to enter the Gulf via groundwater transmission. The actual threat to the Gulf is considered to be very low, given the stringent design requirements of the liner system and the low groundwater flow rate on the coastal plain (Assessment Report, Section 4.7). Rigorous monitoring of groundwater quality downstream of the site and local surface water drainage networks (especially those associated with coastal flooding) should provide an adequate early warning system for detecting any leaks and the subsequent implementation of suitable remedial measures.

Existing and created habitat may be affected by the following threatening processes, which currently operate on site or may result from landfill operations :

- grazing pressure from stock, introduced pest species and insects (resulting in a loss of understorey vegetation, lack of natural regeneration and restricted growth);
- any vegetation clearance/disturbance (resulting in exposed conditions, ‘edge effect’ impacts and increased mistletoe densities);
- land degradation resulting in increased soil erosion and salinity;
- unfavourable soil conditions (due to nutrient deficiencies/imbalances/toxicity, salinity or leachate escape);
- modified hydrology (increased inundation/coastal flooding, groundwater mounding and surface water contamination by leachate or salt).

These factors would need to be suitably managed to ensure the success of revegetation, protection of existing ecological assets and habitat improvements. The EIS (Section 10.11) states that monitoring of flora will be undertaken and records will be taken to provide baseline data, whilst the Response document (Section 8.4) further states that a vegetation management plan forms part of the total management package for the site. It is recommended that the proposed Vegetation Management and Revegetation Plan should also address the management of threatening processes.

4.2 WEED AND PEST CONTROL

The potential risk of landfill activities to public health and the financial viability of surrounding agricultural enterprises is a significant concern raised by the community. In particular, the transmission of disease by animal vectors, such as rats, mice, Silver gulls and Ravens, from the landfill site to local food and water supplies has been raised in public submissions as a threat to intensive animal keeping industries (ie. sheep export trade, chicken rearing, beef feedlots and beef stud farms) and drinking water supplies for residents and communities (esp. the Dublin, Prime Beach and Thompson Beach townships).

4.2.1 Existing Problems

Generally, the condition of the site has been affected by the impacts of traditional agricultural activities practised in the region (ie. grain cropping and sheep grazing), including vegetation clearance, land degradation (mainly by wind erosion), and the spread of introduced plant and animal species. The worst affected areas involve the land surrounding the sheds to the north-west of Section 305 and the previously mined mineral extraction areas.

The EIS (Section 3.15) identifies a number of pest plants occurring on site. A site inspection also revealed the presence of Soursob (Oxalis sp.)*, Long-fruited wild turnip (*Brassica tournefortii*)*, Tread iris (*Gynandriris setifolia*)*, Ice plant (*Mesembryanthemum aitonis*)* and Bridle creeper (*Myrsiphyllum asparagoides*)*.

The EIS (Section 3.17) notes the introduced mammal species that occur on site. In addition, the pest species Silver gull (*Larus novaehollandiae*), Australian white ibis (*Threskiornis molucca*), Common starling (*Sturnus vulgaris*)*, Ravens/Crows (*Corvus* spp.), Domestic pigeon (*Columba livia*)*, Brown hare (*Lepus capensis*)* and invertebrates (eg. flies and mosquitoes) are also expected to be found at the site. [* Denotes introduced species]

The Adelaide Plains Animal and Plant Control Board (APAPCB) have advised the DC of Mallala (Assessment Report, Appendix C1) that the infestation levels on the site of the proclaimed animals, Rabbit, Fox and Mouse are currently high and the proclaimed plants, Horehound, African Boxthorn and Calomba Daisy are firmly established. The Board further advised that adjacent landholders have been made aware of the problems associated with proclaimed animals and plants and are attempting some form of control on their properties.

4.2.2 Potential Risk of Disease Transmission

The potential increased risk of disease transmission from the proposed landfill to agricultural and residential areas has been raised by the community and local producers, however, no evidence of a causal link has been provided.

DPINR advise that congregations of birds, especially migratory waterbirds (eg. Duck and Ibis species), significantly increase the risk of avian influenza and that rodents can carry Fowl Cholera, both exotic diseases which could affect the poultry industry. It is considered that migratory birds are unlikely to be attracted to the landfill site, however, Silver gulls will be attracted. In fact, the Conservation Council of South Australia (CCSA) have data that show the occurrence of Silver gulls is severely reduced at a balefill landfill compared with traditional deposition of waste. The

risk of contamination to drinking water supplies from birds carrying Salmonella is, however, considered to be very low. There is also only a low risk of Salmonella entering the food chain from the consumption of infected beef or chickens from the locality if appropriate monitoring and control measures are not implemented or effective.

Whilst the greatest risk of rodents spreading disease from the landfill site to neighbouring agricultural enterprises is expected to predominantly affect the feedlot immediately north of the site, during mouse plague conditions all local intensive animal keeping properties are considered to be at some risk. It is worth noting that in most agricultural regions poultry broiler and breeder sheds often provide the greatest opportunity for disease transmission by rodents and that the incidence of disease infestations tends to significantly increase following mouse plague episodes (DPINR pers. comm.).

DPINR further advise that provided the landfill does not accept waste that could provide a source for the transmission of disease, the health risk to humans and livestock in the local area is considered to be low.

The balefill would include domestic and commercial wastes and the potential risk of disease transmission would therefore be increased. However, the risk is considered to be no greater than that associated with existing intensive animal keeping activities. The proposed balefill method (inc. a daily cover layer) and small working face would be expected to attract lower numbers of scavenging birds and rodents compared to traditional landfill sites, therefore, reducing the risk of disease transmission. Relevant government agencies (eg. Australian Quarantine Inspection Service, Primary Industries SA and the SA Health Commission) and industry representatives (eg. Inghams Growers Group, Steggles and Nasser Livestock) have been approached and have not raised any significant concerns regarding this issue.

The cumulative impact of existing industries, the proposed landfill, and the recently approved livestock saleyards are considered to significantly increase the potential for disease transmission in the local area (especially during mouse plague conditions), therefore, suggesting a district approach to management and monitoring.

In addition, a study by Fedorak and Rogers (1991) concluded that there should be very little health risk from airborne micro-organisms for landfill workers or residents living near a sanitary landfill site. Furthermore, the operations of a proposed landfill site near Edmonton (Canada) were considered likely to have very little effect on the microbial air quality at nearby chicken and mushroom farms because these types of agricultural operations typically generate extraordinarily high densities of airborne micro-organisms. It should be noted that this study investigated typical sanitary landfills, where microbial aerosols are generated by the mechanical action of dumping and bulldozing at an active face, therefore, the risks associated with a balefill operation are expected to be significantly lower than those reported.

Sound operating practices at sanitary landfill sites (eg. keeping uncovered refuse to a minimum) and sound agricultural practices (eg. preventing wild birds from contacting poultry or their water supplies, food and new litter) would be expected to minimise the risk of spread of pathogens to chickens.

Thus, the risk of disease transmission is considered to be no greater for the proposed landfill than existing agricultural and animal and poultry keeping activities, provided good monitoring and control programs are implemented by those responsible for both activities.

It is recommended that such a program of monitoring of disease transmission be considered at a district level, both in relation to agricultural and animal keeping and landfill activities.

4.2.3 Eradication, Control and Monitoring of Pest Plants and Animals.

It is generally recognised that earthwork activities and the establishment of stockpiles create disturbed sites which are quickly colonised by weed species and that truck movements and landfill activities pose a potential avenue for the introduction and spread of weed seeds. The proposed wheel wash facility and method of operation should adequately address this issue.

The Response document (Section 9.4) states that the numbers of pests attracted to the site can be minimised and the ingress and breeding of pests in the landfill can be prevented by limiting opportunities at the working face and undertaking vector/vermin eradication programs. The EIS (Section 12.4.4) proposes to implement programs for the eradication of weeds (particularly African Boxthorn) and other pests on site prior to the commencement of landfill operations. Section 10.10 of the EIS further states that if scavenging birds or any pest become a problem then a management program will be established and a professional pest exterminator will be immediately engaged. A vermin proof fence will be erected around the perimeter of the site and inspected regularly for rabbit and fox activity as additional control measures. Rabbit proof fencing, as proposed in the EIS (Section 12.4.4), will not prevent the reinvasion of mice from adjacent cleared land.

These measures may be considered adequate in the day-to-day sense (provided management programs are satisfactorily prepared and implemented), however, during mouse plague conditions such control methods may not be effective. Specific control programs, which address “worst case” scenarios would, therefore, need to be prepared (Assessment Report, Section 4.2.2).

The Adelaide Plains Animal and Plant Control Board (Assessment Report, Appendix C1) advise that no material that has the potential to transport proclaimed species that are listed under the *Animal and Plant (Agricultural Protection and Other Purposes) Act 1986* may be removed from the site without prior written approval of the Board.

Ideally, to reduce the potential for reinfestation from surrounding areas, management programs should adopt a regional approach and be prepared and undertaken and periodically revised in consultation with the Adelaide Plains Animal and Plant Control Board and DPINR and co-ordinated with adjoining landowners and/or the proposed LCCC. Such programs should be prepared for both Proclaimed species and 'nuisance' species, which can be detrimental to the ecological value of existing stands of native vegetation and the success of revegetation programs. Surveying and mapping of the occurrence, distribution and extent of all introduced species on site, and possibly adjoining land, would need to be conducted prior to the preparation of management programs.

The Response document (Section 9.4) states that the pest monitoring program will be established as part of the LEMP in order to determine the effectiveness of the control measures.

In conclusion, the detrimental impacts associated with weeds and vermin can be adequately mitigated provided a detailed Plan is prepared and implemented for the whole site. Ideally such a plan would need to cover the landfill site, adjoining properties and roadside verges but this would require a cooperative regional or district approach.

4.3 REVEGETATION

Screen/buffer plantings are expected to be multi-layered where possible and comprise locally endemic species that are established in substrates and landforms they are most suited to. These aspects have been discussed in the section on Visual Impact.

It is considered the documentation would need to provide additional information on revegetation aspects, particularly given the significance attributed to the establishment of screen plantings for reducing the visual impact of the proposal and the difficulties of establishing vegetation in the region. The Response document (Section 8.4) states a Vegetation Management and Revegetation Plan forms part of the total management package for the site. This approach is supported and, therefore, it is recommended that this undertaking be adopted as a condition of development consent or be included in the LEMP.

It is recommended, therefore, that the Vegetation Management and Revegetation Plan be prepared as part of the LEMP, in consultation with relevant government agencies, such as DEHAA and DPINR, and possibly local community groups and should consider the following aspects:

- aims and objectives (inc. projected targets);
- existing site conditions (ie. soil type, depth and salinity; rainfall and evaporation; watertable depth; and landforms);
- establishment of a photographic and survey record of existing features, as proposed in the Response document (Section 8.4);
- factors affecting growth (eg. wind, inundation, high boron levels, presence of calcrete, alkalinity, soil texture & salinity);
- site preparation and weed control (initial and on-going);
- species selection, potential seed sources, seed collection and tubestock propagation;
- establishment of a seed bank, as proposed in the Response document (Section 8.2);
- methodology (ie. tubestock plantings, direct seeding & natural regeneration);
- planting schedule, layout and timing (ie. detailed plans for both the whole site and each stage);
- watering;
- maintenance and follow-up plantings;
- monitoring (including revegetation works), reporting and review.

A discussion of existing revegetation programs conducted in the local area would provide an indication of any limitations or proven methodologies that should be considered (eg. the revegetation activities of the Australian Army Defence Centre - Pt. Wakefield Proof Range and the revegetation of Port Wakefield Road by the Department of Transport). Reference should also be made to any studies on revegetation of landfills, in particular to the research conducted by the MFP for the landscaping of Garden Island.

4.4 METEOROLOGY

The meteorology of the proposed landfill site has bearing on a number of issues raised in submissions including leachate generation, dust control, litter management and the potential for odour impacts. Climatic conditions at the site have been extrapolated from the closest recording stations with no site specific climatic data collected by the proponent. The EPA (Assessment Report, Appendix A) has stated that monitoring and reporting of meteorological parameters at the site would be required as a condition of environmental authorisation should the development be approved.

A number of submissions on the EIS specifically questioned the adequacy of the meteorological data presented by the proponent in the EIS, in particular the District Council of Mallala considered there was insufficient baseline data regarding high winds and rainfall events. Additional information was provided in the Response document and the OEP has indicated that it is now satisfied with the data presented.

Specific issues related to aspects of the site meteorology are discussed below.

4.4.1 Wind

The extrapolated wind data for the site suggest that wind strengths may exceed 20km/hr (the approximate strength above which dust and litter are raised) approximately 30% of the time. The proposed baled method of waste disposal and stringent implementation of the contingency measures described in the Response document (Section 9.2.2) would nevertheless be expected to minimise the occurrence of litter even in these, at times, windy conditions. Careful attention to dust control particularly during cell excavation and liner construction would be necessary. Wetting down may be required on a regular basis with implications for water use.

The Response document (Section 9.1.1) notes that severe storms occur regularly in the vicinity of the Northern Adelaide Plains, but as indicated by the proponent, due to the proposed small size of the active waste placement area and the compressed nature of the waste bales, such storms are unlikely to adversely impact on this aspect of the operation. As noted by the Dublin and Districts Ratepayers Association in their submission, the storms could also cause considerable dust to be generated from the site. During such extreme events dust is likely be generated from a range of land uses in the vicinity, with the landfill site being one of the few able to control the dust generation by use of additional dust suppression measures.

As rehabilitation is undertaken, measures should be implemented to prevent any wind erosion of capped cells occurring prior to establishment of vegetation, this may include use of spray mulch or similar techniques.

4.4.2 Temperature

Data presented in the Response document (Section 9.1.2), indicate that average annual temperatures at the site are likely to be typical of the Northern Adelaide Plains. No information

relating to extreme temperatures and their frequency is provided. These would not be expected to affect the operation of the landfill although the likelihood of odour production would increase with higher temperatures. The effective operation of the landfill gas collection system, however would be expected to minimise the impact of any increased odour production under these conditions.

4.4.3 Rainfall

In the absence of rainfall data collected at the proposed development site, the extrapolation of data from other rainfall stations in the vicinity is adequate to enable calculation of leachate generation volumes and design of stormwater management systems.

4.5 SURFACE WATER, GEOLOGY AND GROUNDWATER

4.5.1 Surface Water

To protect surface water quality, the Response document (Sections 2.2.4 and 6.1) states that three control systems would be developed on site:

a) External Stormwater Diversion (External Catchments Drainage System)
b) On Site Sediment Contact Water (Internal Surface Water Management System)
c) Waste Contact Water

a) External Stormwater Diversion

It is proposed that stormwater entering the site from adjoining land would be retained in natural flow paths, improved to provide containment of 1:100 year return interval events, and directed around and through the site as presented schematically in Figure 6.1 of the Response document. From a water resource protection viewpoint, it is inappropriate for surface stormwater from outside the site to be directed through the site rather than around it. It is recommended, therefore, that should the development be approved, all off site surface water runoff be directed around the perimeter of the entire site and not directed between the proposed fill areas as indicated in Figure 6.1. This would be determined in detail in the LEMP.

The Response document states that vegetation growth within the drains would be promoted to minimise erosion and facilitate uptake of drainage water. Native plant species tolerant of periodic inundation should be selected for this purpose with details included in the Vegetation Management and Revegetation Plan.

According to the Response document (Figure 6.1) the external stormwater drains would terminate in check dams. The intended capacity of these dams is not stated, although Figure 6.2 of the Response document suggests that they would be quite small and hence have low detention periods and limited ability to detain sediment. Eventually it is intended that the external drainage water would be returned to its natural water course. This final discharge should be managed to prevent adverse impacts on any downstream wetlands.

b) Onsite Sediment Contact Water

It is proposed that run-off from the site itself, that has not contacted waste material, would be collected in a separate series of drains terminating in sedimentation ponds from which water would be drawn for dust suppression and vegetation establishment when available. The drains are proposed to be vegetated and capable of dealing with flows from a 1:100 year return interval event, whereas the sedimentation ponds into which they will flow are proposed to have only a 1:25 year, 24 hour storm event capacity. In larger storm events it is proposed that overflow from the ponds would be directed into the external drainage system.

Concerns regarding the impact of water held in the sedimentation ponds potentially causing groundwater mounding are discounted by the proponent who claims that the ponds will not be for long duration storage as water will be taken for dust suppression and irrigation. In winter when the ponds are likely to be full, however, there will be little requirement for water for either of these purposes. The location of such ponds/basins close to stands of native vegetation (esp. low-lying saltmarsh areas), therefore, has the potential to detrimentally affect the health of existing communities as a result of disturbance during construction and groundwater mounding when ponds are filled. It is thus recommended, that all unlined basins and ponds be suitably located, designed and managed to ensure native vegetation is not adversely affected.

c) Waste Contact Water

Run-off that has been in contact with waste would be collected as leachate and treated with other leachate in a single system. The proposed leachate management system is discussed in Section 4.7 below.

From the preliminary design of the inverts of the various drains and ponds comprising the surface water management systems it appears possible that some of these could intersect the watertable, particularly where deepening is necessary to ensure flow in the desired direction (where existing surface contours indicate uphill flow required). The final design would need to demonstrate that the proposed flow regime is achievable and groundwater inflows would not adversely affect the operations of the surface water management system.

The OEP has recommended (correspondence, June 1996) that all drains and sedimentation ponds associated with the internal and external surface water management systems should be constructed in undisturbed ground (not fill) and their base should not intersect the seasonal watertable. To ensure this, further investigation of the fluctuations of groundwater levels would be required.

With reference to the groundwater and leachate (and surface water) control systems, the EPA (Assessment Report, Appendix A) has expressed concern that the methods proposed will require additional investigation of groundwater levels and behaviour on the site in order that the detailed design and construction of the development will offer adequate protection against environmental harm. These investigations should be undertaken prior to finalisation of the detailed design of the landfill and preparation of management plans and would form part of the LEMP.

Treatment of Runoff from Sealed Areas

The proponent has not indicated how they intend to treat runoff from sealed roadways /stands /carparks. The OEP has advised (correspondence, June 1996) that all stormwater runoff from these areas must first be diverted into a stormwater treatment system/device capable of removing

litter, sediment and oil products. Subsequently the runoff should be directed to grassed swales or other vegetated areas, or stored for reuse elsewhere on site. In the event of a large storm, allowance could be made to direct overflow to the internal surface water management system.

Any contaminated runoff originating from the vehicle workshop or wheel washing facility must be contained and treated separately to the satisfaction of the EPA.

Potential for Soil Erosion as a result of Surface Water Movement

As part of the landfilling operation there would be stockpiles of topsoil, fill, cover and capping material on site, at locations to be determined at the detailed design stage. The proponent advises that perimeter drains, berms to prevent excessive slope runoff, sediment control devices and sedimentation ponds would be used to minimise and control the erosion of these materials by water. These and any other measures (such as seeding or covering longer term stockpiles) should be detailed in a Soil Erosion and Drainage Management Plan (SEDMP) as described in the OEP's "Stormwater Pollution Prevention Codes of Practice", which must be prepared and approved as part of the LEMP before the site becomes operational.

Management and Monitoring

Section 4.7 of the Response document indicates that a management plan would be prepared for surface water protection. This would include performance criteria as a guideline to the expected performance levels and to provide an indication of action levels for corrective measures. Contingency plans for incidents such as extreme weather would be included in an Emergency Response Plan. To address their concerns, the EPA have stated that a Surface Water Management Plan (as well as a Soil Erosion and Drainage Management Plan) must be prepared by the proponent, to the satisfaction of the EPA, prior to receipt of any waste. The plan, which would form part of the LEMP, should address the collection and management of all site runoff and management of all surface water flows entering the site from land external to the site. The plan may provide for staging of any surface water management works which may be required as a consequence of the staging of waste disposal activities.

The EIS (Section 10.5) outlines a monitoring program for surface water comprising visual inspections of ponds and water sampling. The Response document (Section 6.1.2) indicates that all open channels would also be regularly checked for sedimentation and cleared when appropriate. It is proposed that sampling and analysis of surface water would be undertaken following procedures specified by the OEP. A range of possible parameters to be measured for water samples is given, however the analyses that would actually be undertaken are not stated, nor the levels at which remedial action would be triggered. These would need to be agreed with the EPA and included in the LEMP for the proposal.

The effect of increased coastal flooding, in response to sea level rise and increased storm surge activity, has not been addressed. Whilst this does not affect the early stages of landfill operations, there is a risk that Stage 9, which is close to a major drainage line connected to the coast, could become inundated during worst-case situations in the distant future. Being the last to be commissioned there is the opportunity for this Stage to be excluded from future operations if monitoring indicates inundation or groundwater movements to be a problem. It is recommended, therefore, that a monitoring program be established to record levels of coastal flooding in the

western section of the site and, if results indicate a significant risk, a review process be undertaken to determine whether to proceed with Stage 9.

4.5.2 Geology

The geology of the landfill site is described in Section 3.10 of the EIS, with additional information provided in Section 5.1 of the Response document. In summary, it is reported that the site is generally characterised by a 0.5-2m thick layer of nodular to massive Ripon Calcrete overlying a 45-55m thick sequence of Hindmarsh Clay, which in turn overlies limestones of the Port Willunga Formation.

As stated in the Response document, the Ripon Calcrete is a hard layer that would need to be removed before landfill liner construction. The proponent claims that site investigations suggest removal solely by ripping would be possible. Given that some of the investigative boreholes failed to penetrate the layer, however, it is possible that blasting could be needed for isolated outcrops. Should this prove to be the case, it is recommended that explosion vibration characteristics and monitoring requirements be determined in consultation with the EPA and District Council of Mallala prior to commencement of any blasting operations.

Whilst primarily a thick sequence of alluvial clay, the Hindmarsh Clay is not homogeneous and some significant bands of clayey sand and sand were found in the upper levels of the site investigation bores. It is not possible to easily assess the width, orientation or lateral continuity of these sandy zones, therefore, the proponent has conservatively assumed that they occur frequently and are continuous for the purpose of groundwater analysis. More definitive information would become available at the time of landfill construction and it is recommended that the OEP (for the EPA) be provided with all additional data concerning the site geology as it becomes available, as this could necessitate minor changes to landfill design or method of operation and the installation of additional groundwater monitoring bores.

The Response document (Section 5.2) indicates that testing of Hindmarsh Clay samples taken from shallow depths at the site has confirmed the general suitability of this material for use in the basal liner and upper cap, provided that adequate compaction is achieved. The proposed supervision of construction and permeability testing of the clay liner and cap by an organisation NATA registered for these geotechnical activities would provide appropriate reassurance that these critical operations are being adequately monitored.

4.5.3 Groundwater

The Response document (Section 5.1) states that below the site there are two groundwater systems relevant to this proposal:

- a shallow groundwater system with salinities of 10 000 - 40 000 mg/L, in the top of, and above the Hindmarsh Clays, in lenses in the clays and in sand lenses and layers that are braided into the clays;

- a deeper aquifer (Port Willunga Formation) confined by the aquitard of the Hindmarsh Clay, from which water (with salinities of 4 000 - 7 000 mg/L) is used for irrigation and stock watering.

The Response document states that any nett water movement between the aquifer systems would probably be upwards from the deep Tertiary aquifer to the shallow groundwater. There is, however, insufficient water level data available to definitively establish the potential direction of groundwater movement between the aquifer systems. The OEP have indicated that they consider the clay between the aquifers, despite its occasionally fissured nature, to be sufficiently thick to provide adequate separation from the underlying deep Tertiary aquifer system for attenuation of contaminants.

The very high salinity of the shallow groundwater restricts its beneficial use, however, it could provide a conduit to adjacent sites and to the coast if the system is continuous beneath and beyond the site. As a worst case scenario, the proponent has assumed this to be the case in modelling studies undertaken and the landfill designed appropriately.

The additional investigations described in the Response document (Section 5.1) indicate that the watertable (the upper surface of the shallow groundwater system) beneath the site is at shallower depth than suggested in the EIS. As a result, the original landfill design proposal as described in the EIS (comprising reworking of the basal clay to an unspecified depth beneath each cell, with a minimum separation of 0.3m maintained between the reworked clay base and the watertable) has been amended so that the base of the landfill (comprising a 1m thick engineered clay liner with a maximum hydraulic conductivity of 10^{-9} m/s) would lie, at least in part, beneath the watertable.

The proponent's investigations and site observations by the OEP confirm that shallow groundwater is continuous beneath the site and beneath adjoining properties. The recorded groundwater levels indicate that the watertable gradient and the direction of shallow groundwater movement is generally south westerly. At this stage there has been insufficient monitoring to establish any seasonal variations in watertable levels or gradients, however the intended monitoring program would rectify this.

4.6 LANDFILL CELL CONSTRUCTION

The Response document (Section 5.3) states that the base liner and capping layer for cells would be constructed from clay obtained from onsite and compacted to yield a low permeability of 10^9 m/sec or less. To provide full encapsulation, the liner system would be constructed over the whole landfill cell base and extended up the sides.

Thickness details and the proposed method by which the liner and cap would be placed is also described in Section 5.3 of the Response document. As indicated therein, placement and compaction of the clay liner and cap should be done under Level 1 Supervision (as defined in AS 3798), by geotechnical consultants NATA registered for these procedures. The liner would then be covered by a drainage layer prior to commencement of balefill operations. Submissions expressed concern that if placement of waste did not commence soon after inspection, shrinkage cracks (due to drying out) could develop in the clay liner and remain undetected beneath the drainage layer. The proponent has responded that the drainage layer over the liner would be kept suitably moist at all times until covered with waste and the cell closed and capped.

Maintenance of the integrity of the capping layer would be essential for effective landfill gas control and to ensure long term stability of the waste mass and successful revegetation. To reduce the likelihood of shrinkage cracks developing in the capping layer it is proposed that a protective layer of material would be placed on top of the cap to prevent drying out. With regard to enhanced rainfall infiltration into the landfill as a result of higher than anticipated permeability of the capping layer due to the development of cracks, and the consequent increase in leachate production, the proponent has incorporated this possibility into the modelling undertaken and subsequently into the landfill design.

4.7 GROUNDWATER AND LEACHATE MANAGEMENT

Each waste disposal cell would have its own separate leachate collection and groundwater control system. The proponent envisages that the separate systems would permit variable leachate and groundwater management practices commensurate with the nature of stored waste and individual cell performance.

To prevent groundwater contamination once waste cells are capped, it is proposed that leachate levels within landfill cells would be maintained below the level of the external watertable, causing an inward hydraulic gradient through the liner to be established, such that no nett outflow of leachate could occur. The proponent (for ease of reference) has named this a Slow Inward Seepage System (SISS) for groundwater protection. It is a common engineering practice with many uses and applications.

4.7.1 Groundwater Interception

Groundwater pumping would be required to lower the watertable in order to allow excavation of the waste cells, installation of the clay liner and deposition of waste. At the completion of waste deposition within the cell, dewatering would be discontinued and groundwater levels allowed to recover.

The Response document (Section 5.5) states that during the operational stage of each balefill cell (estimated to last approximately one year), the groundwater would be held at a level of 2m below the basal clay liner by means of a groundwater interception system. Whilst not described in the text, Figures 5.2 and 5.3 of the Response document suggest that in general terms this system would comprise 2m deep gravel filled groundwater interception trenches located beneath the clay liner, with a 1% slope to enable groundwater to drain to a sump at one end of the cell from where groundwater would be pumped to evaporation ponds. The proponent has advised that the exact method of dewatering to be used for any cell would be decided after the design-level site investigation in each specific area has been carried out.

The Response does not indicate at what depth below the watertable the basal liner would need to be installed to achieve and enable maintenance of the nett inward hydraulic gradient required for effective leachate containment. To work effectively, however, the basal clay liner would need to be installed at a sufficient depth beneath the level of the lowest seasonal watertable to ensure that an adequate inwards hydraulic gradient could be continuously maintained to prevent the outward movement of contaminants by advection or diffusion through the liner. As the magnitude of seasonal watertable fluctuations has not yet been established for the site, the optimal depth of liner installation cannot be determined, however, the landfill cells should be designed to ensure full hydraulic containment of any leachate generated and to minimise differential settlement within the waste mass.

The proponent has advised that the level of the shallow watertable would be monitored continuously for the life of the landfill using shallow wells and automatic data loggers. This data would be used to design successive cell base levels and profiles and could be used to confirm that full hydraulic containment of any leachate generated was achieved. In the long term, raised sea levels would result in raised watertable levels beneath the site, however, this should not adversely impact on the hydraulic containment strategy.

During the operational phase it is likely that dewatering to a minimum depth of 2m below the watertable would be necessary at the upslope end of each cell, in order to allow for the thickness of the clay liner and an adequate depth to accommodate watertable fluctuations. The proponent advises that dewatering would be profiled to follow the cell base profile and not all taken to the same maximum depth. In the extreme case where the surface topography rises as the cell base declines, dewatering trenches may need to be installed to depths of 6-8m below ground level in order to meet the conceptual design specification. The trenches would however be constructed when the base of the cell had already been excavated and therefore normal engineering practice should be sufficient to enable drainage pipeline installation.

During operation of the balefill, to hold the watertable to a depth of 2m below the bottom of the clay liner as proposed, dewatering to a depth of approximately 5-6m below the level of the present watertable would be required at the location of the deepest part of most cells. To achieve dewatering to this depth it is likely that groundwater pumping from beneath adjoining cells would also be required and hence the pumping rate could be greater than that estimated in Appendix A of the Response document. The proponent has subsequently indicated that higher pumping rates of up to 4L/sec would not be a problem, however, as they could be accommodated by relatively small pumps and pipework, and the size of the evaporation pond would still only need to be equivalent to two cell bases. The exact quantity of water to be pumped from below each cell would, however, vary depending on exact subsoil conditions at each cell's location.

The proponent has advised that the optimum location for groundwater evaporation ponds would be determined during the detailed design phase, however, they could either be permanently located in an area such as the 520m buffer zone to the south east of Stage 1, or temporarily located in an area to be used for a future stage and progressively relocated. The capacity of the evaporation ponds would be the total hydraulic loading (rainfall on the pond plus volume of groundwater) balanced with total evaporation on an annual basis. Protection measures would be incorporated to prevent any overflow into the stormwater management system.

4.7.2 Leachate Management

As indicated in the Response document, there would be no risk of leachate migration through the basal clay liner during the operational stages of balefilling within each cell. After closure of the cell and discontinuation of groundwater pumping, groundwater would permeate through the clay liner causing saturation of the waste at the base of the cell and the formation of additional leachate. (Saturation of the lower part of the landfill may stimulate renewed waste degradation in areas not previously degraded. The possibility of this occurring is relatively high because of the overall dry nature of the materials landfilled and the low water influx due to rain).

The volumetric rate of leachate production and the associated rise in leachate levels within the cell would depend mainly upon the rate of groundwater inflow through the liner system and the rate of leachate extraction via the leachate collection system. The proponent estimates it would take approximately 30 years for groundwater and leachate levels to equilibrate if no leachate was extracted. Groundwater would however penetrate the liner and enter the cells in a much shorter time, as indicated by the OEP, who consider infiltration into the deepest part of the cell could commence as early as 1 to 3 years from capping of the cell, depending on the magnitude of the hydraulic gradient caused by dewatering and the in-situ properties of the engineered clay liner.

It is proposed that quantities of leachate would be extracted from inside each cell, as needed, to hold the leachate level below groundwater level outside until monitoring shows that the leachate is benign enough to discontinue the SISS safeguard. The OEP has indicated that only at this stage, and subject to appropriate verification that leachate and groundwater qualities are compatible, would further consideration be given to the possibility of allowing seepage outwards through the liner.

The Response document (Section 5.6) indicates that leachate extracted from the waste cells could be disposed of by pumping into a treatment system or evaporation ponds or by recirculation through the waste mass. The most basic of these three methods would be pumping into a clay lined evaporation pond. The OEP have indicated that any leachate ponds would need to be lined with a barrier.

The proponent has advised that the optimum location for any leachate evaporation ponds would be determined during the detailed design phase, however, they would likely be located in the area proposed for the cell two cells in advance of that currently active. The OEP consider the ponds should be constructed in undisturbed ground (ie not in fill).

The proponent has further indicated that the capacity of the evaporation ponds would be the total hydraulic loading (rainfall on the pond plus volume of leachate) balanced with total evaporation on an annual basis. According to the proponent, a pond area of approximately 20m x 20m would be

adequate to cope with the maximum production of leachate envisaged (at the open landfill stage), after this a smaller pond would suffice. Protection measures would be incorporated to prevent any overflow into the stormwater management system.

If for some reason the leachate extraction system did not operate as intended, leachate levels within the cells would in time equilibrate with the external watertable and the groundwater protection system (SISS), relying upon the inwards hydraulic gradient, would no longer be effective. The leachate level would subsequently rise above the level of the external watertable due to infiltration of rainwater through the cap, thereby reversing the hydraulic gradient and leading to leachate migration outwards through the liner.

The rate at which leachate levels would increase in height above the watertable and the consequent rate of contaminant migration by advection through the basal clay liner would depend primarily on the rate of water infiltration through the capping layer and on the field capacity of the waste. From modelling studies, the proponent estimates a time of 100 to 150 years for leachate to seep out of the cell, based on the calculated rate of water infiltration through the cap, and a liner permeability of 10^{-9}m/sec, however, if allowance is made for the effective porosity of the clay liner, the rate of increase of leachate head within the cell and chemical diffusion gradients, the time taken for leachate to seep out through the cell liner could be greater or substantially less, although still at least 30 years (the time estimated for groundwater and leachate level equilibration).

Even if an inwards hydraulic gradient is maintained, it may still be possible for contaminants to diffuse out of the cell in response to an outwards chemical potential gradient caused by the higher contaminant concentrations within the cell compared with the surrounding groundwater Whilst the quantity of contaminants lost by diffusion would be considerably less than losses due to advection, and would probably mainly involve the more mobile anions, such as chloride and sulphate, these diffusive losses should be minimised. This could be achieved either by ensuring that the leachate level in each cell is maintained at a sufficient depth beneath the level of the external watertable to promote an inwards groundwater flow velocity through the clay liner, sufficient to overcome the diffusive flux, or by maintaining the concentration of contaminants within the cells at sufficiently low levels compared with the concentrations in the groundwater. The desired outcome is that leachate and groundwater levels not be allowed to equilibrate during the time period that leachate of unacceptable quality is being produced. This could necessitate commencement of pumping of leachate within a shorter timeframe than the proponent's expectation of 20 to 35 years after cell closure and at larger extraction rates than the anticipated daily rate of water infiltration through the cap.

Any leachate seeping from Stages 1, 3, 4 and 8 into the underlying groundwater could reach the nearest downgradient site boundary in approximately 40 to 50 years, based on the rate of contaminant movement of 1.2m/year suggested by the proponent. The timeframe of 250 to 500 years estimated in the Response document would mainly apply to the remaining stages. Groundwater monitoring bores would need to be carefully located to ensure detection of any leachate excursions as soon as possible so that appropriate remedial action could be undertaken if necessary.

The amended landfill design does not incorporate any facilities other than the leachate sump for monitoring leachate levels within each cell. As it may be necessary to extract leachate from the sump for extended periods in order to maintain the inward hydraulic gradient, it would be prudent to install at least one leachate monitoring bore within each cell to assist with management particularly if leachate recirculation is incorporated in the management strategy.

The Response document (Section 5.6) stated cleanout risers may be installed as part of the leachate collection system if necessary due to access problems. Details of how cleanout would be achieved in practice would need to be determined. Maintenance of the functional efficiency of the leachate collection system over a long time frame would be fundamental to the effective operation of the groundwater protection strategy. As the drainage layer and drainage pipes would be susceptible to clogging and/or disruption, the proponent would need to include detailed specifications for the installation, operation and maintenance of the leachate collection system, together with a contingency plan to be implemented upon failure of the system, as part of the LEMP for the development.

In conclusion, the landfill proposal incorporating hydraulic containment of leachate within the cells, as conceptually described in the Response document, has the potential to provide adequate safeguards against pollution of the underlying groundwater and the off-site movement of contaminants via the groundwater system. For the groundwater protection system to be effective, however, it is imperative that the basal clay liner of each cell be installed at a sufficient depth to ensure full hydraulic containment can be achieved by an adequate inwards hydraulic gradient preventing advective and diffusive loss of contaminants.

Monitoring of groundwater and leachate levels and careful management of the leachate collection/extraction system would be required to ensure that an adequate inwards hydraulic gradient is continuously maintained over the time frame that leachate of unacceptable quality is being produced to ensure its full containment.

With reference to the groundwater and leachate (and surface water) control systems, the EPA has commented that the methods proposed will require additional investigation of groundwater levels and behaviour on the site in order that the detailed design and construction of the development will offer adequate protection against environmental harm. These investigations should be undertaken prior to finalisation of the detailed design of the landfill and preparation of management plans and will form part of the LEMP.

It is recommended that if the development is approved, the proponent would need to demonstrate in the LEMP that the methods proposed to be employed to control leachate, surface water and groundwater contamination will meet EPA requirements..

Further hydrogeological investigations should be carried out prior to the commencement of any landfill construction in order to fully define the dewatering and groundwater disposal requirements for cell construction to achieve full hydraulic containment of leachate.

The EPA has stated that should development authorisation be granted for the landfill, a detailed Groundwater and Leachate Management Plan must be prepared by the proponent to the satisfaction of the EPA, prior to receipt of any waste. The plan must demonstrate that the method of hydraulic containment proposed can be practicably achieved. The plan may provide for staging of leachate and groundwater management works which may be required as a result of the staging of waste disposal activities upon the site.

5. EPA AND COUNCIL COMMENTS

Pursuant to Section 46 B (5)(a)(i) of the *Development Act 1993*

> " after the EIS has been prepared, the Minister must, if the EIS relates to a development or project that involves, or is for the purposes of, a prescribed activity of environmental significance as defined by the *Environment Protection Act 1993*, refer the EIS to the Environment Protection Authority; and must refer the EIS to the relevant council (or councils), and to any prescribed authority or body; and may refer the EIS to such other authorities or bodies as the Minister thinks fit,"

EPA Comments and Report

The EIS (and Response document) were referred to the EPA for comment and the Authority carried out a site inspection, met with the proponent and sought additional comment from the local community. The Authority's comment and report is included in Appendix A of the Assessment Report. The EPA highlighted areas of concern being:

- methods proposed to be employed to control leachate, surface water and groundwater contamination requiring additional investigation for preparation of a management plan (refer Assessment Report, Section 4.4 and 4.5);

- preference for a 500m buffer zone within the depot boundary and under the control of the proponent (refer Assessment Report, Section 3.7);

- potential effect on the agricultural pursuits in the area (potential loss of $33 million per annum from livestock industry) as well as the potential impact on poultry sheds and piggeries (refer Assessment Report, Section 3.12);

- a mechanism must be put in place to enable cessation of waste reception at the completion of any stage of the development should management of the site not be undertaken as specified in the response document and in a Landfill Environmental Management Plan which is to be prepared (refer Assessment Report, Section 1.2).

  Note: If a breach of a condition of a development authorisation occurs as a result of an activity then remedies are provided for in the relevant Act. If a circumstance arose, as postulated by the EPA, then it would be expected that this would be dealt with using powers provided under the EP Act rather than ordering the cessation of the land use for waste disposal. This could involve remedial action as ordered by the EPA, and changes to the process so that future waste disposal does not result in further pollution.

These areas of concern have been addressed in this assessment.

Council Comments and Report

The District Council of Mallala (Assessment Report, Appendix C1) provided an extensive 20 page submission, with appendices, outlining its views on the proposal.

Key concerns of the Council were:

- The site is located exceptionally close to the coastline. If leachates and other externalities are generated by the landfill, which then extend beyond the boundaries of the site, serious environmental, social and economic impacts will result;

- The influence of the coastal area and coastal systems on the site, particularly in respect to fluctuating water table levels, have not been seriously considered;

- It is considered that the proximity of the subject land to the coast makes the site unacceptable for the proposed use;

- The high level water table and the suggested methods of site preparation, involving digging down to two (2) metres in depth, will more than likely result in leachate penetration;

- The laying of synthetic liners should be an absolute minimum requirement;

- The impacts generated by the establishment and ongoing operations of the landfill facility on surrounding general farming enterprises have not been addressed. The impacts on the adjoining salt pan harvesting industry, being critical to the local and state economy, also needing further consideration;

- The EIS has not adequately addressed the social impacts on the existing and future communities located adjacent to the site and surrounding areas;

- Their is insufficient soil on site to meet the requirements of the facilities daily operations;

- The establishment of the landfill would be in contravention of Council's Development Plan provisions.

Following the release of the Response document the Council provided further comment (Assessment Report, Appendix C2). The Council considers that the thrust of the Response document is that all of the issues have been addressed or are able to be addressed through the application of appropriate scientific expertise and technology and the Response document has:

- a tendency to overstate the ability to address all of the environmental concerns;

- a tendency to overstate the Expert's knowledge and their ability to know from the data collected and the research undertaken;

- a tendency to promote the proposal as a technological wonder and the answer to South Australia's future waste management needs.

The Council is also critical of the approach, not only by the proponent but by government, to waste management.

6 MANAGEMENT, MAINTENANCE AND POST CLOSURE MONITORING

The proponent was not required to provide a detailed Landfill Environmental Management Plan (LEMP) for the environmental/development assessment phase of the proposal. A detailed LEMP is necessary for EPA licensing if the proposal is granted a development approval. Specific measures to address identified environmental impacts are, however, discussed in the EIS and Response document.

Many of the potential impacts identified and mitigation measures proposed are supported, in particular:

- commitment from the proponent to a financial assurance package in accordance with industry standards to cover the liability for the current operation together with ongoing monitoring and post closure programs as required;

- the Port Wakefield Road and entrance to the balefill junction to be upgraded to the satisfaction of the Department for Transport, Urban Planning and the Arts (Transport SA) formerly DoT with costs to be borne by the proponent;

- adoption of the proposed noise control measures and hours of operation as set out in the EIS and Response document;

- sealing of the site access road for a minimum of 520m from the nearest residence.

Proposed mitigation and operational measures supported but requiring more development and detailing through the licensing process and the preparation of a LEMP are:

- design and establishment of the buffer zone;
- management and storage of surface water;
- washdown facility design and operation;
- erosion and litter control;
- pest plants and animal control;
- monitoring (especially of groundwater) and leachate levels;
- gas and odour control, both during the operational phase and post-closure;
- screening measures, especially from surrounding roads;
- management of native vegetation.

Specific plans referred to in this Report, including the EMS, Vegetation Management and Revegetation Plan, Soil Erosion and Drainage Management Plan (SEDMP), Pest Plant and Animal Management Plan, Surface Water Management Plan, and Groundwater and Leachate Management Plan, should all be incorporated in the LEMP.

The specific plans should include or address the following to the satisfaction of the EPA.

Vegetation Management and Revegetation Plan

Screening/Buffer Aspects

- Due to the potentially slow establishment and growth conditions of the site it is considered that all perimeter plantings should be started as early as possible to achieve maximum amelioration of visual impacts. Plantings along the north-western boundaries should commence immediately.

- The perimeter fence should be screened by suitable plantings where adequate natural screening is not provided and all built structures and internal roads should be adequately screened using suitable species in accordance with the Vegetation Management and Revegetation Plan.

- To provide additional screening and wildlife habitat the following options should be investigated :

    - revegetation of the road reserve along Prime Beach Road, in conjunction with the DC Mallala and the community.
    - revegetation of the road reserve along Port Wakefield, in conjunction with the Department of Road Transport, to further reduce views from the eastern direction.
    - plantings on private property along fence lines adjoining the site, in conjunction with landowners and the community.

- The buffer layout should be redesigned so that all firebreaks and external drainage channels are located on the inner edge of the vegetation screen and existing stands of native vegetation. In the event that drainage channels are required to be located close to the site boundary, they should be redesigned to form low-lying wetland/saltmarsh communities as part of the vegetated screen.

- Stock piles should be located in areas that provide adequate screening (ie. near areas of existing vegetation) and the use of saline water for erosion control (esp. on the buffer mound) should be avoided in preference to alternative measures.

Native Vegetation Management and Revegetation Aspects

- Preparation of a Vegetation Management and Revegetation Plan should be prepared in consultation with relevant government agencies, such as DEHAA and DPINR, and the local community, and include the following:

    - the management of remnant vegetation stands, and threatening processes.
    - the establishment of a seed bank.
    - a scientific description of vegetation communities (ie. structure, cover, abundance, condition etc.) and a community distribution map (ie. baseline monitoring).
    - revegetation aspects (ie. final species selection, screen density and composition and methodology).

  and those further identified in Section 4.3.

- Revegetation should comprise species endemic to the local provenance which are planted/seeded on landform types they are most suited to. The physical and chemical properties of the planting medium should also be taken into account. Direct seeding should be adopted as the preferred method for the long-term establishment of small tree, shrub, groundcover and grass species. Growth of the trees should be monitored and any additional replacement planting be undertaken.

- Greater long-term screening may be achieved progressively by establishing vegetation cover up the final landform rather than relying on an immediate visual barrier at the base of the mount.

- The proposed establishment of a photographic and survey record of existing features (ie. baseline monitoring) should include both vegetation management and revegetation aspects.

- All landfill activities (inc. vehicle movements) should avoid remnant stands of native vegetation and individual trees to a minimum distance of 5m (ideally 10 m) from the dripline of the canopy edge. Such a buffer should be delineated using clearly visible marker pegs and site operators should be made aware of the need to avoid native vegetation.

- All sedimentation basins and evaporation ponds should be suitably located, designed and managed to ensure native vegetation (esp. low-lying saltmarsh communities) is not adversely affected by construction activities or groundwater mounding.

- Low-lying saltmarsh communities should be protected from further degradation and measures be adopted to improve their ecological value, especially if such areas are to be used for the management of surface water.

- An amount of additional water available for plant growth should be maximised by the effective management of site run-off.

- Post closure, the entire landform could be planted with appropriate types of native vegetation cover. This would need to be determined in the licensing process.

Pest Plant and Animal Management Plan

Introduced Plants and Animals

- A comprehensive Pest Plant and Animal Management Plan should be implemented prior to landfill operations commencing to ensure the site is free of as many pest species as possible from the onset and adequate monitoring and follow-up control should occur. Such a plan would need to cover the landfill site, adjoining properties and roadside verges. Specific control programs to address 'worst case' scenarios (eg. mouse plague conditions) should also be prepared. Any changes to control programs should be made in consultation with the Adelaide Plains Animal and Plant Control Board and ideally the proposed Community Consultative Committee.

- Surveying and mapping of the occurrence, distribution and extent of all introduced species on site, and possibly adjoining land, should be conducted prior to the preparation of management programs.

- Measures should be implemented to avoid the dispersal of proclaimed species by any animal, plant, soil, vehicle, farming implement or other produce or goods. Eradication of proclaimed species prior to earthworks commencing, on-going monitoring and follow-up control programs will be required. In addition, the movement of public and vehicles will, therefore, need to be restricted to areas cleared of proclaimed plants.

- Monitoring and control programs to reduce the risk of disease transmission should be prepared by adopting a district approach, in coordination with the Adelaide Plains Animal and Plant Control Board, DPINR and landowners.

Soil Erosion and Drainage Management Plan (SEDMP), Surface Water Management Plan,

Surface Water

- To minimise and control any onsite soil erosion (particularly of stockpiled material) a Soil Erosion and Drainage Management Plan (SEDMP) as described in the OEP's "Stormwater Pollution Prevention Codes of Practice", should be prepared and approved, as part of the LEMP, before the site becomes operational.

Dust Control

- As part of the LEMP, a Surface Water Management Plan should address the collection and management of all site runoff (including any contaminated runoff originating from roadways, carparks and hardstands, the vehicle workshop or wheel washing facility) and management of all surface water flows entering the site from land external to the site in particular to ensure their final discharge does not impact adversely on any downstream wetlands.

- Surface water drainage channels should be designed to support sustainable low-lying vegetation communities, using endemic species where practicable, and be included in the Vegetation Management and Revegetation Plan.

- A monitoring program should be established to record levels of coastal flooding in the western section of the site and, if results indicate a significant risk, a review process be undertaken (ideally through the LCCC) to determine whether to proceed with Stage 9.

- Damping down using borewater should be restricted to the landfill area and alternative measures for controlling erosion (eg. hydro mulch seeding of the earthen buffer mound, establishing native grass cover on stockpiles and areas of bare earth, using rubble for internal roads etc) be investigated and adopted where practicable.

- As rehabilitation is undertaken, measures should be implemented to prevent any wind erosion of capped cells occurring prior to establishment of vegetation, this may include use of spray mulch or similar techniques.

Groundwater and Leachate Management Plan

- To enable detailed design of the proposed groundwater protection system, to determine the minimum depth at which the landfill cells should be based and to enable detailed design of the surface water management system, further investigation of groundwater levels and behaviour on the site should be undertaken prior to finalisation of the detailed design of the landfill and preparation of management plans.

- As part of the LEMP, a detailed Groundwater and Leachate Management Plan should demonstrate that the method of hydraulic containment proposed can be practically achieved. The plan may provide for staging of leachate and groundwater management works which may be required as a result of the staging of waste disposal activities upon the site, and should include contingency measures to be implemented upon failure of the leachate management system.

- A leachate monitoring bore should be installed within each cell to assist with leachate management particularly if leachate recirculation is incorporated into the management strategy.

- Groundwater monitoring bores would need to be carefully located to ensure detection of any leachate excursions as soon as possible so that appropriate remedial action could be undertaken if necessary.

Monitoring

The Response document (Section 10.3) states that post closure monitoring would be carried out for 25 years. Monitoring of the leachate would initially be on a monthly basis with six monthly reporting or as required by the EPA. Groundwater monitoring and reporting would continue on a six monthly basis, or as required by the EPA. The proponent states (Clarification of Issues, Section 2.5),

> "*The amended concepts allow progressive stage closure and implementation of post closure monitoring and landfill stage stabilisation during the operating life of the balefill. Given the last two stages (Stage 8 and 9) are shown with 21 cells (8 and 13 respectively) that last for approximately 21 years, all previous stages 1 to 7 will be fully stabilised by the time Stage 9 is filled. Post closure monitoring of only Stage 8 (for 12 years) and Stage 9 (for 25 years) would therefore be required. If recirculation of leachate is able to be used to improve the rate of degradation of wastes and increase landfill gas production, stabilisation and the requirement for post closure monitoring may be shortened (subject to the approval of the relevant Authorities).*"

Landfill gas monitoring and the management of the gas system will continue until gas production ceases. The proponent anticipates that energy production of approximately 10mw of electricity could be achieved during full gas production (Clarification of Issues, Section 6).

A 16 point post-closure inspection checklist is provided in the Response document (Section 10.4.7). The approach to long term monitoring proposed would ensure that the balefill stabilisation process is monitored and unpredicted occurrences can be controlled.

Conclusion

Should development approval be given for this balefill proposal the proponent would be required to prepare and have approved, by the EPA, a detailed LEMP before an operating licence would be issued. The LEMP should include any additional measures identified in Sections 3 and 4 of this Assessment Report, including:

- appropriate site preparation and management of the SISS system to eliminate risk of contaminating groundwater;
- appropriate site management to prevent contamination of surface waters;
- appropriate preparation of site to manage surface water flows;
- appropriate management of native vegetation;
- appropriate control and management of pest plant and animal species;
- appropriate measures to control erosion on perimeter mounds and landfill cover;
- appropriate handling of wastes of working face of landfill;
- appropriate preparation of perimeter mounds, including screening proposals (especially revegetation);
- appropriate monitoring program;
- commitment to annual reporting of all monitoring data, research findings and actions taken to mitigate adverse impacts;
- undertaking to report to the EPA any significant departures in management from those proposed in the EIS and Response document.

7. CONCLUSIONS

The assessment of the environmental implications of the proposed IWS Northern Balefill has required the consideration of a range of social, economic and environmental issues.

Advice from the Environment Protection Authority has been incorporated into this Report as required by the *Development Act 1993* and also as it will be responsible for the determination of licensing requirements (under the *EP Act 1993*) if development approval is granted. The Office of Environment Protection (OEP) also provided comments earlier in the assessment process and these have also been used, however the statutory powers in these matters rest with the EPA, rather than the OEP.

The District Council of Mallala had input by way of a written submission and provided further comment outside the statutory process (Appendix C1 and C2). As well, the Planning Strategy, the Development Plan and all government and public comments have been considered.

The proposal, as presented in the EIS and Response documents, is a concept and if development approval is granted, preparation of the final detailed design will be required for EPA licensing purposes.

It is concluded that the following issues have been satisfactorily addressed in the EIS and Response document to enable the Governor to give decision on development. There are conditions recommended in relation to these issues:

- visual impact;
- waste transport;
- infrastructure;
- noise;
- litter;
- buffers;
- air quality;
- weed and pest control;
- native vegetation and fauna;
- meteorology;
- geology, groundwater, and surface water;
- leachate handling proposals.

The following conclusions have been grouped into areas of interest in relation to the proposal.

Consistency with Government Policy

- The Development Plan for the District Council of Mallala through development control principles 17, 91, 145 provides guidance to the types of development that may be undertaken in the General Farming Zone.

- The proposal, whilst not conforming with some of the objectives and principles of development control for the zone, is considered to not be at serious variance with the Development Plan current at the time of lodgement of the proposal in 1994.

- The proposal is non complying in the Development Plan authorised on 1 May 1997.

- The Planning Strategy in 1994 made no reference to waste facilities in the district. In 1996 the Strategy envisaged strategically located specialised industries such as waste disposal.

Noise

- The predicted noise levels would comply with the requirements of the Environment Protection (Industrial Noise) Policy between the hours of 7 am to 10 pm for an area described as predominantly rural.

Social Impacts

- The proposed IWS Northern Balefill would change the present land use of the site from that of rural grazing land to a landfill site which would be quite extensive in years to come but which would be progressively rehabilitated.

- The community at Dublin which is approximately 3km distant and at Thompson Beach approximately 3 km from the site have indicated their opposition to the proposal in submissions.

- A buffer area has been proposed around the landfill site but not within the subject land's boundary. The closest dwelling to the site is presently 520m away. If the EPA decide to require a 500m buffer around the site further land division or residential building construction would not be permitted. It is considered that due to the size of the existing adjacent parcels this is unlikely to be a major problem, further, it is unlikely that the adjacent land will be required for denser subdivision.

- Gas and odour generation would be managed and mitigated according to specific requirements defined during licensing.

- Development of a large landfill to the north of the metropolitan area would provide a valuable waste disposal asset when many of the existing and operating sites are reaching capacity in the northern area.

Visual Impact

- The visual impact of the proposed landfill would be expected to change over time. Initially, the creation of the screen mound and the outer slope of each active stage would gradually establish prominent features on the landscape that, whilst screened to a large degree by vegetation, would be highly visible due to their large scale and slightly elevated height (ie.

compared to the relatively flat nature of the local topography). They would also remain obvious because of their green cover of native vegetation, especially during times of the year when the surrounding country has 'browned off'. The completed site is expected to have the appearance of a series of large vegetated mounds within a predominantly cleared flat landscape. Progressive and final revegetation of the landfill and the establishment of screen plantings around the site perimeter, and possibly adjoining roadside reserves, should adequately mitigate the visual impact of the site, especially from Pt. Wakefield Road and Prime Beach Road.

Traffic

- The projected increase in traffic above existing levels (4%) is considered to not be significant. Subject to the upgrading of the service road and the Port Wakefield Road intersection (to DoT specifications) traffic issues would be adequately managed.

Infrastructure

- No adverse impacts from the provision of infrastructure at the site have been identified.

- Detail on the design and operation of the wheel wash facility, can be provided in the LEMP.

Heritage

- The Department of State Aboriginal Affairs has confirmed that there is no entry in the Aboriginal Register of Sites and Objects on the subject land.

- A full survey of the site has been carried out by an archaeological team together with Kaurna Committee and community members. The Kaurna Committee has not objected to the development of this site.

- No sites of non-Aboriginal heritage have been identified on the proposed balefill.

Economic

- Given the existing conditions, the proposed change of land use is not expected to detrimentally affect the existing primary industry based, economic viability of the region.

- Benefits to the local community have not been detailed but it is envisaged that between 2 and 10 people will be employed.

- Long and short term impacts of the proposal on adjoining property values have been difficult to predict given the influences that determine property values. Little or no impact on adjacent rural land values is anticipated.

- The location and method of waste disposal is unlikely to lead to a significant increase in waste management costs.

- The proponent's commitment to a Financial Assurance Strategy is essential to ensure that funding is available to carry out any necessary remediation measures both during the life of the landfill and after closure.

Biological and Physical Issues and Impacts

Biological Issues

- The detrimental impacts of the proposal on existing native flora are expected to be minimal, with any disturbance to native vegetation being far outweighed by proposed revegetation and weed control measures. However, further detailed investigations and the preparation of a Vegetation Management and Revegetation Plan are required to ensure the successful establishment of plantings and the sustainable management of existing communities.

- The potential impacts on existing native fauna are expected to be minimal, with any disturbance to fauna being far outweighed by the proposed expansion and improvement of available habitat in the area, provided existing stands of native vegetation are sustainably managed, suitable revegetation is successfully undertaken and pest plants and animals (including Silver gulls and Ravens) are adequately controlled.

- The risk of disease transmission is considered to be no greater for the proposed landfill than existing agricultural and animal and poultry keeping activities, provided good monitoring and control programs are implemented by those responsible for both activities.

- The detrimental impacts associated with weeds and vermin can be adequately mitigated provided a detailed Plan is prepared and implemented. Ideally such a plan would need to cover the landfill site, adjoining properties and roadside verges but this would require a cooperative regional or district approach.

Meteorology

- In the absence of rainfall data collected at the proposed development site over a number of years, the extrapolation of data from other rainfall stations in the vicinity is considered adequate to enable calculation of leachate generation volumes and design of stormwater management systems.

- The proposed baled method of waste disposal and stringent implementation of contingency measures would be expected to minimise the occurrence of litter even at times of windy conditions. Careful attention to dust control particularly during cell excavation and liner construction would however be necessary. Wetting down might be required on a regular basis with implications for water use.

- Monitoring and reporting of meteorological parameters at the site would be required as a condition of environmental authorisation should the development be approved.

Stormwater Management

- The proponent would need to prepare a Surface Water Management Plan to the satisfaction of the EPA prior to the receipt of any waste. The Plan should address the collection and management of all site runoff as well as management of surface water flows entering the site from land external to the site. Any such Plan may provide for staging of surface water management in conjunction with the staging of waste management.

- The final design of the surface water management system would need to demonstrate the proposed flow regime is achievable and that groundwater inflows would not adversely affect its operations.

- To ensure that all drains and sedimentation/siltation ponds associated with the internal and external surface water management systems are constructed in undisturbed ground (not fill) and that their base does not intersect the seasonal watertable, further investigation of the fluctuations of groundwater levels would be required.

Geology

- Over much of the proposed landfill site, the Ripon Calcrete would need to be removed before landfill liner construction. Whilst this could probably be achieved mainly by ripping, it is possible that blasting could be needed for isolated outcrops.

- Clays of the Hindmarsh Clay are suitable for use in the basal liner and upper cap of the landfill, provided that adequate compaction is achieved. The proposed supervision of construction and permeability testing of the clay liner and cap by an organisation NATA registered for these geotechnical activities will provide reassurance that these critical operations are being adequately monitored.

Groundwater

- The very high salinity of the shallow groundwater precludes its beneficial use, however it could provide a conduit to adjacent sites and to the coast if the system is continuous beneath and beyond the site. As a worst case scenario, the proponent has conservatively assumed this to be the case in modelling studies undertaken and the landfill designed appropriately.

- Although there is insufficient water level data available to definitively establish the potential direction of groundwater movement between the two aquifer systems present beneath the site, the OEP have indicated, however, that they consider the clay between the aquifers to be sufficiently thick to provide adequate separation from the underlying deep Tertiary aquifer system, for attenuation of contaminants.

- The watertable beneath the site is at shallower depth than originally advised, which has necessitated amendment of the landfill design so that the base of the landfill would lie, at least in part, beneath the watertable. At this stage there has been insufficient monitoring to establish any seasonal variations in watertable levels or gradients, however the intended monitoring program would rectify this.

Groundwater Interception and Leachate Management

- The landfill proposal incorporating hydraulic containment of leachate within the cells, as conceptually described in the Response document, has the potential to provide adequate safeguards against pollution of the underlying groundwater and the off-site movement of contaminants via the groundwater system. For the groundwater protection system to be effective, however, it is imperative that the basal clay liner of each cell be installed at a sufficient depth to ensure full hydraulic containment of leachate can be achieved by an adequate inwards hydraulic gradient preventing any advective and diffusive loss of contaminants.

- As the magnitude of seasonal watertable fluctuations has not yet been established for the site, the optimal depth of liner installation cannot be determined, however, the landfill cells should be designed so that full hydraulic containment of leachate can be achieved.

- Monitoring of groundwater and leachate levels and careful management of the leachate collection/extraction system would be required to ensure that an adequate inwards hydraulic gradient is maintained over the time frame that leachate of unacceptable quality is being produced to ensure full hydraulic containment of this leachate.

- In the long term, raised sea levels would result in raised watertable levels beneath the site, however this should not adversely impact on the hydraulic containment strategy.

- As part of the groundwater interception system, drainage trenches are proposed to extend beyond the excavated base of the cell and may need to be installed to depths of 6 to 8m below ground level in order to meet the conceptual design specification. Provided these trenches are installed when the cells have already been excavated, standard engineering practices should be sufficient to overcome any construction difficulties in pipeline installation.

- To achieve dewatering to the required depth below each cell, it is likely that groundwater pumping from beneath adjoining cells would also be required. This may necessitate a higher pumping rate than that suggested by the proponent, however it is likely that this could be accommodated by the proposed infrastructure, and this should be demonstrated at the detailed design stage.

- The optimum location for groundwater evaporation ponds would be determined during the detailed design phase.

- As indicated in the Response document, there would be no risk of leachate migration through the basal clay liner during the operational stages of balefilling within each cell.

- The OEP considers once dewatering operations were discontinued, the time for groundwater infiltration into the deepest part of the cell could commence as early as 1 to 3 years from capping of the cell, depending on the magnitude of the hydraulic gradient caused by dewatering and the in-situ properties of the engineered clay liner.

- It is proposed that quantities of leachate would be extracted from inside each cell as needed to prevent equilibration of leachate and groundwater levels until monitoring showed that the leachate was benign enough to discontinue the SISS safeguard. The OEP have indicated that only when independent monitoring verified the compatibility of the leachate and external groundwater quality, would consideration be given to the possibility of allowing any outwards seepage of leachate.

- If for some reason the leachate extraction system did not operate as intended, leachate levels within the cells would in time equilibrate with the external watertable and the groundwater protection system relying upon the inwards hydraulic gradient would no longer be effective. The rate at which leachate levels would increase in height above the watertable and the consequent rate of contaminant migration by advection through the basal clay liner would depend primarily on the rate of water infiltration through the capping layer and on the field capacity of the waste. If allowance is made for the effective porosity of the clay liner, the rate of increase of leachate head within the cell and chemical diffusion gradients, the time taken for leachate to seep out through the cell liner could be greater or substantially less than the 100 to 150 years estimated by the proponent, although still at least 30 years (the time estimated for groundwater and leachate level equilibration if no leachate pumping were undertaken).

- Any leachate seeping from Stages 1, 3, 4 and 8 into the underlying groundwater could reach the nearest downgradient site boundary in approximately 40 to 50 years, based on the rate of contaminant movement of 1-2m/year suggested by the proponent. Groundwater monitoring bores would need to be carefully located to ensure detection of any leachate excursions as soon as possible so that appropriate remedial action could be undertaken if necessary.

8. RECOMMENDATIONS

If the Governor were to give consent to the proposal the following conditions are recommended, either in relation to any development authorisation or licensing.

Traffic

- Detailed design of the opening and associated left turn deceleration lane from Pt. Wakefield Road, as well as the construction, should be completed to the satisfaction of the Department for Transport, Urban Planning and the Arts with all costs being borne by the developer.

- Entrance to balefill junction to be upgraded to the satisfaction of the Department for Transport, Urban Planning and the Arts (Transport SA) formerly DoT with costs to be borne by the proponent.

- Sealing of site access road for minimum of 520 metres from the nearest residence.

Screening/Buffer Aspects

- Due to the potentially slow establishment and growth conditions of the site it is considered that all perimeter plantings should be started as early as possible to achieve maximum amelioration of visual impacts. Plantings along the north-western boundaries should commence immediately.

- Screening by suitable plantings where adequate natural screening is not provided, should be provided for the perimeter fence, all built structures, stockpiles and internal roads (where practicable) using suitable species in accordance with the Vegetation Management and Revegetation Plan

- To provide additional screening and wildlife habitat the following options could be investigated by the proponent, council, community and local landowners:

    - revegetation of the road reserve along Prime Beach Road, in conjunction with the DC Mallala and the community.
    - revegetation of the road reserve along Port Wakefield, in conjunction with the Department for Transport, Urban Planning and the Arts (Transport SA) to further reduce views from the eastern direction.
    - plantings on private property along fence lines adjoining the site, in conjunction with landowners and the community.

- The buffer layout should be redesigned so that all firebreaks and external drainage channels are located on the inner edge of the vegetation screen and existing stands of native vegetation. In the event that drainage channels are required to be located close to the site boundary, their redesign to form low-lying wetland/saltmarsh communities as part of the vegetated screen should be investigated.

Native Vegetation Management and Revegetation Aspects

- Preparation of a Vegetation Management and Revegetation Plan should be required as a condition of development consent and be included in the LEMP. The Plan should be prepared in consultation with relevant government agencies, such as DEHAA and DPINR, and the local community and have regard to the measures suggested in the Assessment Report particularly in Section 6.

- All sedimentation basins, evaporation ponds, and surface water drainage channels should be suitably located, designed and managed to ensure native vegetation (esp. low-lying saltmarsh communities) is not adversely affected by construction activities or groundwater mounding, and if possible the ecological value enhanced.

Introduced Plants and Animals

- A comprehensive Pest Plant and Animal Management Plan should be implemented prior to landfill operations commencing to ensure the site is free of as many pest species as possible from the onset and adequate monitoring and follow-up control should occur, as discussed in the Assessment Report.

- Whilst not totally within the control of the proponent, monitoring and control programs to reduce the risk of disease transmission should ideally be prepared by adopting a district approach, in coordination with the Adelaide Plains Animal and Plant Control Board, DPINR and landowners.

Surface Water

- To minimise and control any onsite soil erosion (particularly of stockpiled material) a Soil Erosion and Drainage Management Plan (SEDMP) as described in the OEP's "Stormwater Pollution Prevention Codes of Practice", should be prepared and approved, as part of the LEMP, before the site becomes operational.

- As part of the LEMP, a Surface Water Management Plan should be prepared by the proponent to the satisfaction of the EPA prior to receipt of any waste. The plan should address the collection and management of all onsite surface water (including any contaminated runoff originating from roadways, carparks and hardstands, the vehicle workshop or wheel washing facility) and management of all surface water flows entering the site from land external to the site in particular to ensure their final discharge does not impact adversely on any downstream wetlands.

- A monitoring program should be established to record levels of coastal flooding in the western section of the site and, if results indicate a significant risk, a review process be undertaken (ideally through the LCCC) to determine whether to proceed with Stage 9.

Geology

- If blasting is required to remove any of the Ripon Calcrete, explosion vibration characteristics and monitoring requirements should be determined in consultation with the EPA and District Council of Mallala prior to commencement.

- The OEP should be provided with all additional data concerning the site geology as it becomes available as this could necessitate minor changes to landfill design or method of operation and the installation of additional groundwater monitoring bores.

Groundwater

- To enable detailed design of the proposed groundwater protection system, to determine the minimum depth at which the landfill cells should be based and to enable detailed design of the surface water management system, further investigation of groundwater levels and behaviour on the site should be undertaken prior to finalisation of the detailed design of the landfill and preparation of management plans.

Groundwater Interception and Leachate Management

- Further hydrogeological investigations should be carried out prior to the commencement of any landfill construction in order to fully define the dewatering and groundwater disposal requirements and to provide sufficient assurance that the cells can be dewatered and constructed in accordance with the requirements for full hydraulic containment of leachate. In particular, monitoring of watertable levels should commence immediately in order that the magnitude of seasonal fluctuations can be fully established prior to construction of the landfill.

- As part of the LEMP, a detailed Groundwater and Leachate Management Plan should be prepared by the proponent to the satisfaction of the EPA, prior to receipt of any waste. The plan should demonstrate that the method of hydraulic containment proposed can be practically achieved. The plan may provide for staging of leachate and groundwater management works which may be required as a result of the staging of waste disposal activities upon the site, and should include contingency measures to be implemented in the event of any failure of the leachate management system.

- A leachate monitoring bore should be installed within each cell to assist with leachate management particularly if leachate recirculation is incorporated into the management strategy.

Post Closure Aspects

- A more sustainable after-use for the site that will encourage the regeneration and rehabilitation of natural communities should be considered during future post closure planning.

- If appropriate with the desired end use to be determined in more detail at a later stage, the entire landform should be planted with appropriate types of native vegetation cover.

- Determination of interim and post closure land uses of the site, proposed to be undertaken in association with the Local Community Consultation Committee, should be undertaken as required by the EPA as part of the LEMP.

9. SCHEDULE OF ACTS, REGULATIONS AND CODES OF PRACTICE APPLICABLE

Aboriginal Heritage Act 1988
Animal and Plant Control (Agricultural Protection and Other Purposes) Act 1986
Development Act 1993
Development Plan - District Council of Wakefield Plains
Environment Protection Act 1993
Native Vegetation Act 1991

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11. GLOSSARY

AHD	Australian Height Datum (approximate mean sea level)
Anaerobic	The absence of free oxygen
AQIS	Australian Quarantine Inspection Service
AS	Australian Standard
CBD	Central Business District
CCSSA	Conservation Council of South Australia
CFS	Country Fire Services
dB	Decibels
DEHAA	Department of Environment, Heritage and Aboriginal Affairs
DHUD	Department of Housing and Urban Development
DoT	Department of Transport [now DTUPA (Transport SA)]
DPINR	Department of Primary Industries and Natural Resources
DTUPA	Department for Transport, Urban Planning and the Arts
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMS	Environment Management System
EPA	Environment Protection Authority
ETSA	Electricity Trust of South Australia
LCCC	Local Community Consultative Committee
LEMP	Landfill Environmental Management Plan
LFG	Landfill gas
live face	(working face) area of exposed waste at any time
m	metres
MESA	Mines and Energy South Australia

mg/L	Milligrams per litre
MHUDLGR	Minister for Housing, Urban Development and Local Government Relations
MTUP	Minister for Transport and Urban Planning
NATA	National Association of Testing Authorities
OEP	Office of Environment Protection
SEDMP	Soil Erosion and Drainage Management Plan
SISS	Slow Inward Seepage System

APPENDIX B

LIST OF LOCALLY ENDEMIC SPECIES OF NATIVE VEGETATION CONSIDERED SUITABLE FOR USE IN REVEGETATION.

As a general guide the following fast growing species should be considered for revegetation:

- *Eucalyptus socialis*
- *Pittosporum phylliraeoides***
- *Myoporum insulare*
- *Acacia ligulata***
- *A. hakeoides***
- *A. salicina***
- *A. notablis*
- *Senna artemisioides nothossp. coriacea*
- *Dodonaea viscosa ssp. spatulata*
- *Eremophila longifolia***
- *Maireana brevifolia*
- *M. pyramidata*
- *Muehlenbeckia gunnii*
- *Senecio lautus*
- *Dianella revoluta*
- *Clematis microphylla*

As a general guide the following slow growing species should be considered for revegetation:

- *Eucalyptus gracilis*
- *E. dumosa*
- *Alectryon oleifolius ssp canescens***
- *Exocarpus aphyllus*
- *Melaleuca lanceolata*
- *M. acuminata*
- *Geijera linearifolia*
- *Santalum acuminatum***
- *Acacia sclerophylla*
- *Rhagodia candolleana*
- *Westringia rigida*
- *Atriplex paludosa*
- *Scaevola spinescens*
- *Threlkeldia diffusa*
- *Tetragonia implexicoma*
- *Zygophyllum aurantiacum*

** denotes the ability to regenerate by producing suckers.

As a general guide the following grass and groundcover species should be considered for revegetation:

- *Danthonia spp*
- *Stipa spp*
- *Atriplex semibacatta*
- *A. suberecta*
- *Enchylaena tomentosa*
- *Maireana aphylla*
- *Rhagodia candolleana*
- *R. parabolica*