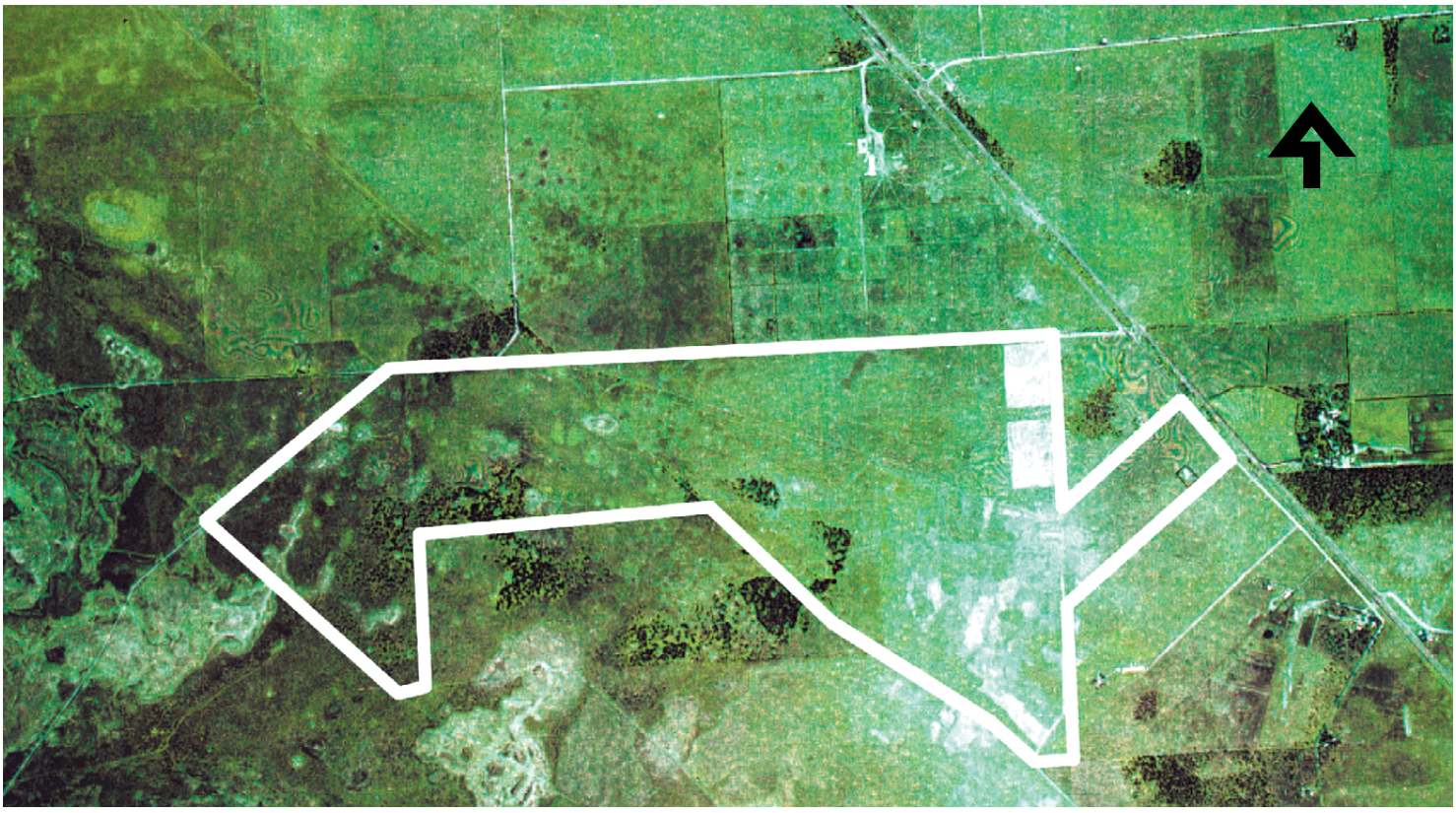
Development Act 1993

AMENDMENT TO THE ASSESSMENT REPORT

For the Environmental Impact Statement for the

IWS Northern Balefill



Government of South Australia

AMENDMENT TO THE ASSESSMENT REPORT

For the Environmental Impact Statement
For the
IWS Northern Balefill

Planning SA
Department of Primary Industries
and Resources SA

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Minister for Urban
Development and Planning

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1 INTRODUCTION

This amended Assessment Report (AAR) has been prepared by the Minister for Urban Development & Planning and assesses the environmental, social and economic impacts of a proposal by Integrated Waste Services Pty Ltd (IWS) to receive and dispose low level contaminated soil (LLCS) and liquid treatment plant residues (LTPR) at the IWS Northern Balefill (balefill) landfill. The balefill is located approximately 50 kilometres north of Adelaide and 3 kilometres south of Dublin, in the District Council of Mallala. This report is written as a comprehensive document. However further information on establishment of the IWS balefill site can be obtained from the November 1997 "Assessment Report for the Environmental Impact Statement for the IWS Northern Balefill".

1.1 BACKGROUND

IWS obtained development authorisation from the Governor on 29 January 1998 to establish and operate a balefill near Dublin. Solid waste material from metropolitan Adelaide is processed at the IWS Resource Recovery and Transfer Facility (RRTF) located at Wingfield. The RRTF receives waste from domestic, commercial and industrial premises, building and demolition waste and green waste. Waste material not able to be recycled at the RRTF is compressed into bales (where the material allows this to be undertaken) and is then transported to the IWS landfill and placed into a cell that has a compacted clay liner and drainage layer and collection system for liquid (leachate) that permeates through the waste. The Environment Protection Authority (EPA) issued a licence to IWS on 1 September 2001 to enable operation of the landfill, which was commissioned on 22 May 2002.

On 22 October 2002 the Development Assessment Commission (DAC) granted an amended development authorisation, under delegation from the Governor. This amendment refined the nexus between commitments by IWS in the EIS and the initial EPA licence. In particular, the development approval was amended to remove the shredding and baling requirement for waste physically unsuitable for shredding and baling, such as construction and demolition materials.

On 17 April 2003, IWS made an application to the DAC to vary the development authorisation to enable the reception and disposal of the low level contaminated soil (LLCS) and liquid treatment plant residues (LTPR). As the essential nature of the development would be changed, the DAC was not able to grant an amended development authorisation under its delegated powers from the Governor.

The Minister determined that the proposed new waste was not envisaged in the earlier EIS, and accordingly an amended EIS should be prepared by IWS in accordance with the relevant provisions of the *Development Act 1993.* The document titled "EIS Amendment Receipt of Low Level Contaminated Soils and Liquid Treatment Plant Residues at the IWS Northern Balefill, July 2003" (Amended EIS) was prepared by the proponent and included details of the proposal and anticipated effects.

1.2 ENVIRONMENTAL IMPACT ASSESSMENT PROCEDURES

Section 47 of the Development Act 1993 enables the Minister to exhibit the Amended EIS. Following a public display period for the Amended EIS between 27 August and 17 September 2003 all submissions were forwarded to IWS and a Response Document (RD) was prepared by IWS to address matters raised in public submissions and government comments on the Amended EIS. Supplementary Information was subsequently provided by IWS to further clarify design issues to the reasonable satisfaction of the EPA.

Pursuant to Section 47 of the *Development Act 1993*, in preparing this AAR, consideration has been given to; the original EIS; the Amended EIS; submissions from the public, the EPA and other government agencies, comments from the District Council of Mallala; the proponent's RD on the submissions, Supplementary Information provided by the proponent and any other matters considered relevant.

Pursuant to Section 48(7) of the *Development Act 1993* the Governor 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 *Development Act 1993*, 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 Amended EIS and the AAR. Further, as indicated 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.

2. PROJECT DESCRIPTION

2.1 PROJECT JUSTIFICATION

The Amended EIS (Section 1.2) states that due to market pressures and requests by waste producers, IWS undertook a review of its operation and assessed the potential to service a need for a facility to dispose LLCS and LTPR. IWS concluded that a facility, separate from the balefill disposal area, could be designed and established at the Northern Balefill site.

The proponent is of the view that the proposed LLCA and LTPR cells have been designed to a higher standard than currently exists for the disposal of LLCS and LTPR in South Australia.

In section 2.1 of the Amended EIS, IWS provides what it considers to be key attributes of the proposal:

- Specific design for containment of LLCS and LTPR by provision of a double liner and leachate collection system;
- Detailed knowledge of the waste products;
- Site suitability in terms of soils and hydrogeological conditions;
- Strict operational and environmental management;
- Appropriate post closure management;
- Siting north of Adelaide to reduce risks of transporting material through metropolitan Adelaide;
- Disposal in a remote area away from residential developments; and
- Safe access roads.

2.2 THE SITE

The receipt and disposal of LLCS and LTPR is proposed to occur at the existing approved and licensed IWS Northern Balefill. The IWS Northern Balefill is currently licensed by the EPA as a Waste or Recycling Depot (EPA Licence No. 11275) and is permitted to receive the following wastes:

- Domestic waste that has been baled, except for non-friable asbestos;
- Commercial waste and industrial waste that has been baled;
- Construction and demolition waste that has been sorted so as to remove papers, plastics, organic materials (such as green waste) and metallic materials (such as metal sheeting and containers);
- Green waste that has been shredded or baled;
- Waste fill (formerly defined as clean fill);
- Intermediate landfill cover (as defined by the EPA);
- Waste containing non-friable asbestos;
- Bulky waste within any of the above categories, shredded if necessary for effective compaction of the bales; and
- Pieces of automotive tyres not exceeding 250 mm.

A Landfill Environmental Management Plan (LEMP) was prepared by IWS as part of the licence application and additional management measures relating to the LLCS and LTPR have been developed as part of the current proposal, and these will be incorporated in the LEMP, if granted development authorisation by the Governor.

It is proposed to utilise an area of the approved balefill (designated as Stage 4) for the LLCS and LTPR facility, with commencement of development at cell 31 and if waste volumes justify further development would occur at cells 30, 25 and 26 (Refer to Figure 1).

2.3 CURRENT LAND USE

The IWS Northern Balefill has development authorisation and a licence to receive and dispose primarily baled waste. Establishment of the LLCS and LTPR facility within the existing waste depot does not represent a change in land use, as these materials are waste products.

IWS has indicated that the adjacent land uses have not changed since February 1996 (section 3 of Amended EIS) and comprise, intensive animal keeping facilities within 1 km of the property boundary (namely piggeries, feedlots, chicken and poultry) and two residences within 500 m of the eastern property boundary.

2.4 THE PROPOSAL

This section describes the proposed development and outlines the proposed method of operation. It is proposed to have the same hours of operation as the balefill:

2.4.1 Infrastructure

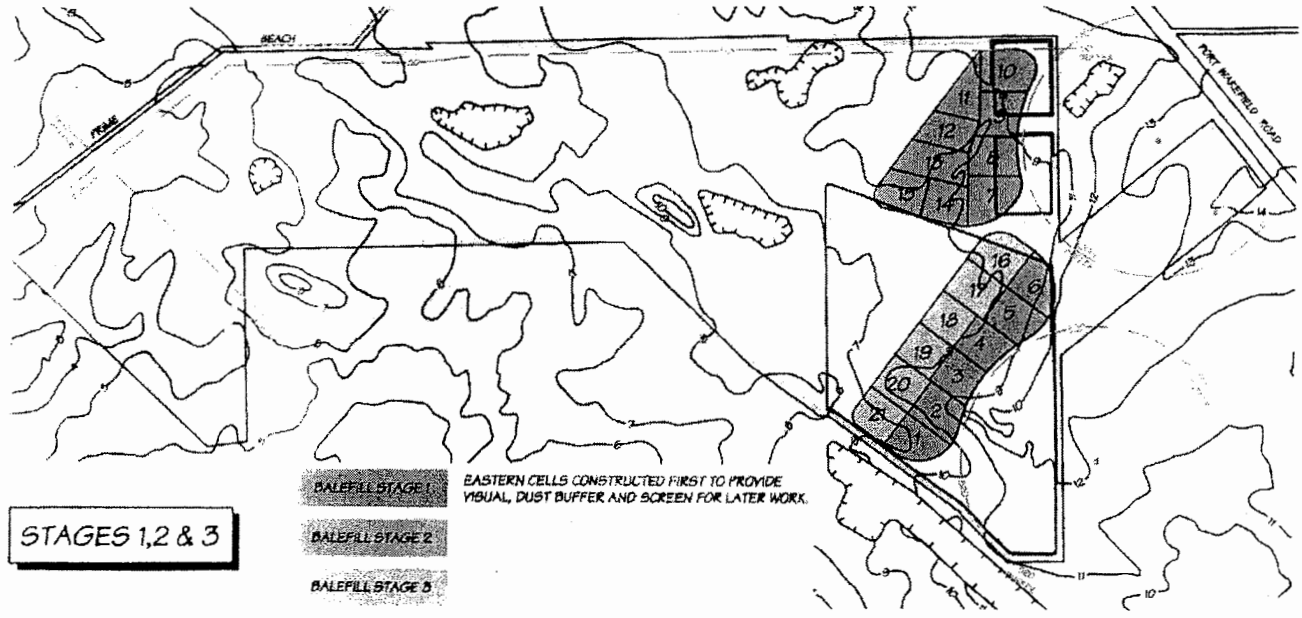
The balefill site is connected to electricity, mains pressure water, telephone services and a septic tank for sewage facilities (section 3 of Amended EIS).

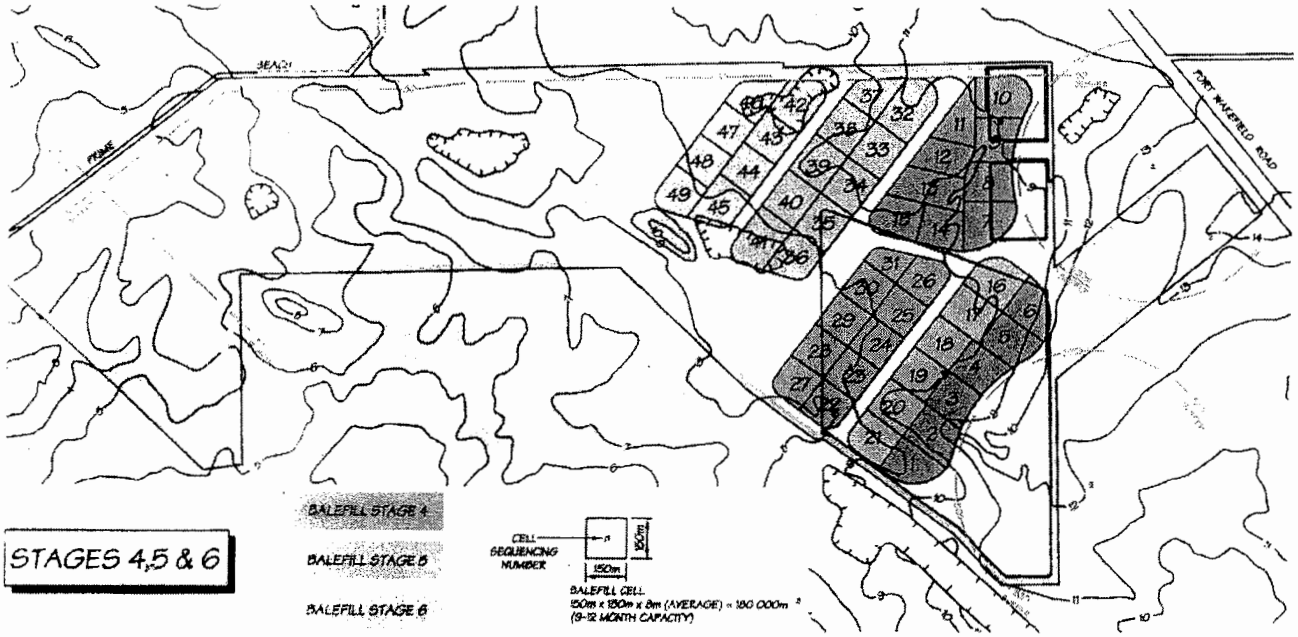
A sealed road extends from the entry gates to a weighbridge and gatehouse. Staff amenities have been established in a caretaker's residence, which enables an IWS staff member to be present at all times. A workshop is also located on the balefill site to enable the maintenance of plant and equipment used at the site.

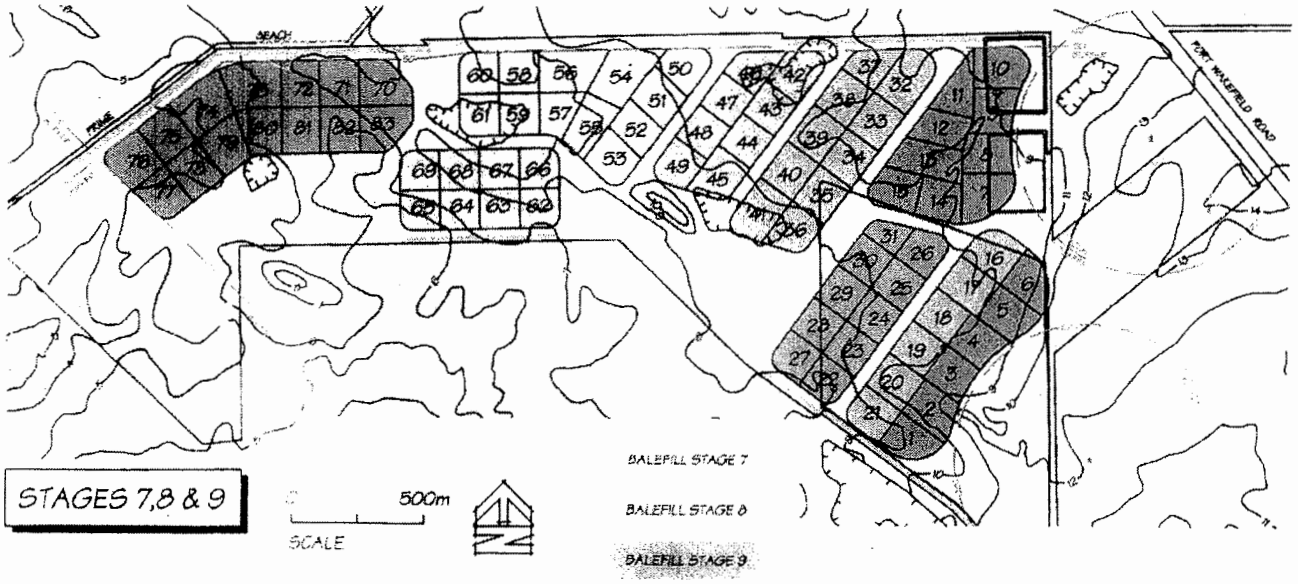
2.4.2 Method of Operation

The LLCS and LTPR are proposed to be disposed in engineered cells that are separate from the balefill disposal cells.

Cell staging will be undertaken progressively, commencing at cell 31 (Refer to Figure 1) and development of adjoining cells 30, 25 and 26 undertaken, subject to the availability of LLCS and LTPR (section 8.2 of Amended EIS). The proposed layout for cell 31 is indicated in Figure 2.







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CLIENT: INTEGRATED WASTE SERVICES		PROJECT: LOW LEVEL CONTAMINATED SOIL CELL	
DRAWN: CRC 13/08/2004		TITLE: LANDFILL STAGING PLAN	
CHECKED:			
SCALE: AS SHOWN	A4	PROJECT No: 04663307	3307D05

xref:- J:\2004\ENV\04663307 DUBLIN\DWG\3307D05
cadfile:- J:\2004 env\04663307 Dublin\dwg

LEACHATE COLLECTION PIPE

LEACHATE DETECTION PIPE

LEACHATE COLLECTION SUMP

CREST OF EMBANKMENT
RL 13.5m WIDTH 5m

A D02

RISER BUNDING

LEACHATE SUMP RISER
EXTRACTION PIPE

TOP OF LINER RIDGELINES
SHOWN DASHED

JOIN TO NATURAL
SURFACE LEVEL

1V : 3H

RL 11.99m

RL 11.85m

2%

RL 10.90m

RL 12.52m

RL 12.81m

RL 12.40m

1%

C D03

RL 11.16m

CELL 31

SOLID RISER PIPE ON BATTER
SLOPE FOR FLUSHING OF
LEACHATE COLLECTION PIPES

RL 11.63m

2 x 180mm Ø PIPES
SPACED < 300mm APART
1m RADIUS AT BEND

RL 11.85m

GEOSYNTHETIC ANCHOR
TRENCHING

B D03

SOLID RISER PIPE ON BATTER
SLOPE FOR FLUSHING OF
LEACHATE COLLECTION
PIPES

RL 12.49m

BATTER SLOPE 1V : 3H

CELL 26

LEGEND

● RL 12.20m - SURFACE ELEVATION AT BASE OF AGGREGATE m(AHD)

0 10 20 30 40
SCALE IN METRES

CELL 30

CELL 25

REVISION	DESCRIPTION	INITS	DATE	INITS	DATE
				CHECKED	APPROVED
P2	REVISED PRELIMINARY ISSUE				
P1	REVISED PRELIMINARY ISSUE				
P0	PRELIMINARY ISSUE				

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CLIENT: INTEGRATED WASTE SERVICES PTY LTD

PROJECT: LOW LEVEL CONTAMINATED SOIL CELL

DRAWN	DATE	DRAWING CHECK	DATE
TJM	4/11/04		
DESIGNED	DATE	DESIGN CHECK	DATE

DRAWING TITLE: CELL 31 DESIGN PLAN

AUTHORISED	DATE	SCALE		PROJECT No	DRAWING No	REVISION
		1:800	A3	04663307	3307D01	P2

As indicated in the Amended EIS, and subject to revisions as detailed in the RD and Supplementary Information by the proponent, the cells will include a lining and leachate collection system as indicated in Figure 3, and comprising the following:

- A primary leachate collection layer consisting a 300 mm thick drainage blanket and piping, located below the waste;
- A primary composite liner, comprising 600 mm thick compacted clay liner (permeability $<1x10^{-9}$m/sec) placed beneath a 1.5 mm high density polyethylene (HDPE) geomembrane liner and geotextile protection layer;
- A secondary HDPE drainage net as a leakage detection system and if required for extraction of any seepage through the primary lining system; and
- A secondary 600 mm compacted clay liner below the drainage net.

A buffer distance of 5 m will be maintained between the balefill cells and the LLCS and LTPR cells (section 8.2 of RD and Supplementary Information).

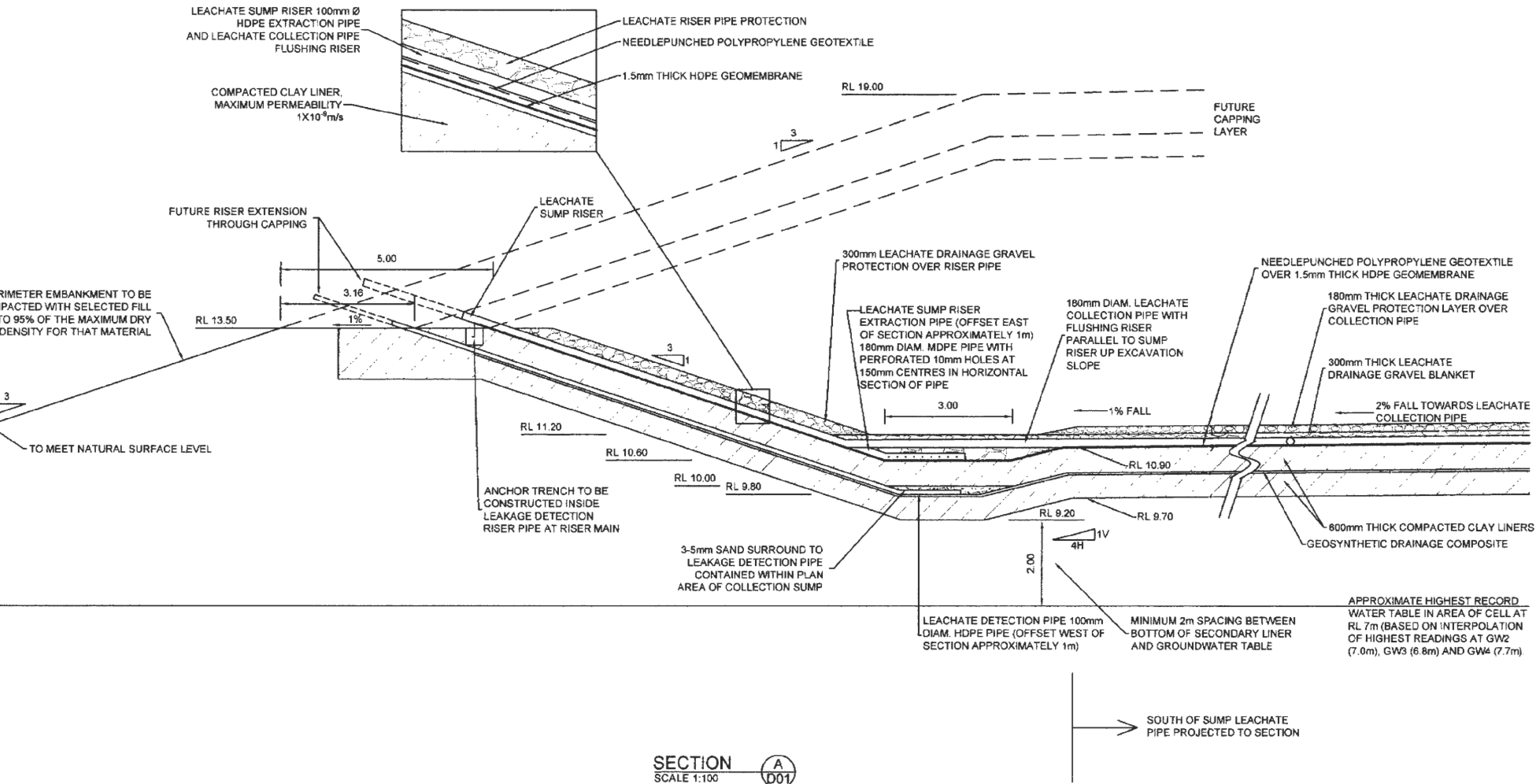
The compacted clay liner is proposed to be constructed in layers not exceeding 200 mm following compaction, to make up the full 600 mm thick liner. The clay liner material will be obtained from the site. Geotechnical testing will be carried out by a National Association of Testing Authorities (NATA) registered geotechnical testing authority under Level 1 Supervision as determined by Australian Standard AS 3798-1996. The leachate drainage system will consist of a high porosity material sloped at 2% to the leachate collection pipes and thereafter at a 1% slope to a collection sump. The construction of the HDPE liner will be undertaken in accordance with a quality assurance and testing program.

Operational cells would be progressively rehabilitated with a 0.6m thick low permeability clay layer directly above the waste and overlain by a 1.0m thick layer of soil to enable plant growth and as moisture control medium (section 10 of Amended EIS and section 4.1 of RD). A 150 mm thick daily cover will be placed on the waste material (section 4.1 of RD).

Surface water diversion and storage were discussed in the RD (section 3.4 and Appendix F). Internal and external surface water drains would be provided, with drainage to evaporations ponds. Runoff from waste disposal areas would be considered to be leachate and dealt with as indicated below.

2.4.3 Leachate Management

Computer modelling (Appendix E of RD) undertaken by IWS indicates that there will be negligible seepage from the cells. A system of groundwater monitoring wells will be installed to enable testing of groundwater quality down gradient of the cells (section 8.3 of the Amended EIS and RD).



SECTION A
SCALE 1:100
D01

LEGEND
RL 9.60 - Elevations m(AHD)

REVISION	DESCRIPTION	INITS	DATE	INITS	DATE
P1	REVISED PRELIMINARY ISSUE				
P0	PRELIMINARY ISSUE		24/8		

CHECKED | APPROVED

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CLIENT: INTEGRATED WASTE SERVICES

DRAWN	CRC	DATE 25/08/04	DRAWING CHECK	DATE 18/2/05
DESIGNED		DATE	DESIGN CHECK	DATE
AUTHORISED		DATE	SCALE 1:100	A3

PROJECT: LOW LEVEL CONTAMINATED SOIL CELL
DRAWING TITLE: SECTION A LINER AND SUMP DESIGN

PROJECT No	DRAWING No	REVISION
04663307	3307D02	P1

codfile = J:\2004\env\04663307\dwgs

Leachate that is collected by the drainage layer will be dealt by either of the following means:

- direct extraction into an onsite tanker vehicle suitable for the transport of leachate into an onsite leachate evaporation pond; or
- direct extraction into a licensed tanker vehicle and transported to an off site licensed Waste Water Treatment Plant; or
- direct extraction into a suitably designed, temporary on-site storage tank prior to off-site disposal by a licence tanker vehicle and transported to a licensed Waste Water Treatment Plant or prior to on-site transport into a leachate evaporation pond

The evaporation ponds are required to be constructed with a low permeability compacted clay and HDPE liner. The leachate evaporation ponds will be separate to the stormwater ponds.

2.4.4 Air Emissions and Noise

The proponent refers to the existing LEMP for the proposed management and monitoring provisions for odours and other air emissions and noise (section 9.3 of Amended EIS). IWS has indicated that its modelling of potential odour and vapour emissions (Appendix B of RD) indicates that there would be no risk to the nearest sensitive receptors.

2.4.5 Pest Plants, Vermin and Litter

The Amended EIS (section 9.5) makes reference to the LEMP for management of pest plants, vermin and litter. These measures are appropriate for the proposed LLCS and LTPR facility.

2.5 CONSEQUENCES OF NOT PROCEEDING

The proponent has not specifically addressed implications of not proceeding with the proposed development. In section 2.1 of the Amended EIS, IWS states that establishment of the LLCS and LTPR cells at the Northern Balefill site would reduce the risks associated with transport of these listed wastes through metropolitan Adelaide. In addition the proponent has indicated that this facility, if approved, would be to a higher technical standard than currently exists in South Australia.

3. CONSISTENCY WITH GOVERNMENT POLICIES

When making a development decision on a major development or project for which a declaration applies, the Governor must have regard to the Planning Strategy, provisions and regulations in the Development Plan and if relevant, Building Rules. In addition where the development involves a prescribed activity under the *Environment Protection Act 1993*, the Governor must have regard to the objects of the Act, the general environmental duty and any relevant environment protection policies.

Since development approval was granted to the IWS Balefill in January 1998 there have been amendment to the Planning Strategy and Development Plan. The following sections assess the proposal against relevant provisions of the Planning Strategy and Development Plan at the time of application.

3.1 PLANNING STRATEGY

In making a decision on the Amended EIS the Governor must have regard to the Planning Strategy for Regional South Australia, January 2003. The Planning Strategy sets out the State Government's vision for development and directions for future growth and development for the community, the private sector and local government. The Planning Strategy is based on the integration of economic, social and environmental factors pertinent to regional South Australia.

General

Economic activity/development

The regional area has a mixture of broad hectare farming and intensive animal keeping. Key strategies of relevance to the proposal include:

- Prevent the loss of productive land, minimising encroachment by inappropriate uses and reduce the potential for conflict.
- Where necessary, provide separation distances between land uses incompatible with primary industry.
- Increase the use of productive land for sustainable agriculture, including an adequate supply of land and buffers for specific key intensive animal keeping uses.

The proposal involves the reception of additional waste materials at an approved waste depot on land that is now alienated from agricultural use and no additional land will be lost from agricultural use. There are adequate buffers established at the site and management and monitoring measures ensure there would not be impacts on adjacent land uses.

Environment and resources

The Strategy indicates that measures should be taken to protect, restore and enhance the quality of the environment having regard to the principles of ecologically sustainable development. Key principles relevant to the proposal include:

- Facilitating identification and remediation of site contamination.
- Promoting waste avoidance and resource recovery.
- Promoting cleaner production, use of sustainable resources and regionally based waste management, recycling and re-use practice.

The proposal involves the establishment of a facility to receive contaminated soil that has originated from the cleanup of contaminated sites. Without appropriately designed and managed facilities able to service metropolitan Adelaide and regional areas, remediation of site contamination may not occur or result in higher costs to the community. This facility will primarily service the northern metropolitan area but would also be available to the regional community.

Community health and resources

The Strategy indicates that the storage, collection, transport and disposal of waste require high standards to safeguard public health and safety and minimise environmental impact. It promotes a regional approach to waste management, which, by combining resources, the cost of developing modern waste management infrastructure can be spread among several organisations. The following strategies are applicable:

- Consider community and industry requirements for noise and air quality control when developing performance-based policies.
    - Use separation distances and other performance-based measures to reduce conflicts between land use sensitive to noise and/or reduced air quality.
    - Promote the use of technologies that minimise the potential generation of noise and air pollutants.
- Locate waste facilities in an orderly and rational manner.
    - Prepare and implement local and regional waste management strategies that include recycling and re-use.
    - Minimise the impact of waste operations on public and environmental health and safety.
    - Locate landfill sites to avoid potential impacts on communities and minimise impact to the environment including contamination of the ground and surface water.
    - Encourage, promote and coordinate efforts to improve efficiencies and economies of scale in solid waste management.
- Manage hazardous industrial, commercial and household waste.
    - Reduce the discharge of industrial waste into the sewerage system.
    - Ensure that government and industry manage listed wastes effectively and efficiently.
    - Ensure the safe and efficient transport of listed wastes to protect the community and the environment.
    - Involve the community, industry and government in regional approaches to integrated waste management and planning, including exchange of information and discussion, development and understanding of the proposals and opportunities to contribute to decision-making

The proposal involves the establishment of a facility for receipt of LLCS and LTPR at an existing waste depot. This means there is no need to establish a new facility at an alternative

location and therefore provides for an orderly, efficient an economical option for management of listed wastes. Establishment of the facility in an approved waste depot enables EPA approved management and monitoring practices to be implemented and upgraded thereby minimising potential impacts on the community. The design of the facility is to a high standard and together with the management and monitoring measures proposed will minimise impacts to the environment including contamination of groundwater and surface water. Community involvement has occurred through the public consultation process associated with this proposal.

Water quality and quantity

- Integrate water resource policies and local water planning with land use planning.
    - Ensure water dependent ecosystems in streams, wetlands, flood plains and estuaries are viable and thriving and water quality is maintained or enhanced.
    - Protect water catchments and storage areas from poor land use and management.
    - Protect underground water supplies from overuse and pollution.
- Protect catchments from poor land use and management practices.
    - Identify and reduce sources of pollution for each region, catchments and ground water basin.
    - Provide incentives and information on managing pollution, both point source and diffuse.
    - Regulate waste disposal and management of polluting activities through codes of practice, licences and guidelines.
    - Protect underground water supplies from overuse and pollution.
    - Establish regional water quality standards for waste disposal and reuse.
    - Develop, monitor and update pollution management plans.

The high standard of design of the containment system for the LLCS and LTPR and proposed management and monitoring systems will ensure there are no adverse impacts on water resources and surface waters.

Northern Adelaide Plains

The Strategy indicates that the economy of the Northern Adelaide Plains is based on primary production, with broad hectare cropping and grazing common and capital intensive agriculture such as poultry farms, feedlots and piggeries also being significant contributors. In the Strategy it is indicated that there is potential for conflict between these intensive industries and surrounding land uses by the very nature of their operations, such as odours, dust, traffic and waste.

It is also recognized in the Strategy that the area is well placed to capitalise on industrial development because of its proximity to commodities and markets as well as transport linkages. These advantages are also present in the western parts of the area for the attraction of specialized 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, however the location, together with intensive forms of agriculture, must be carefully planned according to standards agreed by the industry and community.

Economic Activity Strategies

- Preserve the asset base of agricultural areas for animal and grain production and encourage measures to improve farm management, product diversity and value and soil conservation.
- Identify appropriate remote areas within the Mallala district suitable for the location of specialised industries such as waste disposal and stock or slaughter yards.
- Amend Development Plans by introducing comprehensive, performance-based policies that reflect industry requirements, land capability, environmental characteristics and responsible resource management for development in rural areas.
- Facilitate the establishment of new businesses based on the competitive advantages of the area, including access to major transport routes, availability of land and separation distances from adjoining land uses.

Environment and Resources Strategies

- Maximise sustainable use of regional water supplies by managing demand and providing opportunities to supply future needs.
- Protect and supplement recharge and retrieval of groundwater aquifers.
- Implement a 'total water cycle management' approach to regional water supplies.

The proposal involves the establishment of additional waste disposal activities at an approved and EPA licensed balefill that has limited value for agricultural use. There are adequate buffers around the proposed facility to mitigate potential impacts on adjacent land uses.

Shallow groundwater located below the site is not suitable for irrigation, stock watering or for human consumption. The irregular nature of the shallow aquifer and low yields would preclude its use for sustainable aquifer storage and recovery. Regional water supplies rely on deeper aquifers. The high standard of design of the containment system for the LLCS and LTPR and proposed management and monitoring systems should ensure there are no adverse impacts on water resources.

Conclusion

The proposal is consistent with the Planning Strategy, provided the potential impacts can be managed appropriately. Sections 5 and 6 of the AAR consider the issues in detail.

3.2 THE DEVELOPMENT PLAN

The relevant Development Plan is the Mallala (DC) Consolidated version dated 30 January 2003. The Development Plan contains policies relating to the Outer Metropolitan area and the Council Wide area. The existing balefill and proposed cells for the receipt of LLCS and LTPR is within the General Farming Zone.

Outer Metropolitan

The proponent has not provided an assessment of the proposal in terms of the Outer Metropolitan area provisions.

Objective 37 The retention of rural areas primarily for agriculture, pastoral and forestry purposes, and the maintenance of the natural character and beauty of such areas.

The proposed development is within the approved Northern Balefill, which by its nature precludes further agricultural use on the land.

Council Wide

IWS has indicated that Objectives 34 and 35 of the waste management provisions are applicable to the project:

Waste Management

Objective 34 *The orderly and economic development of waste management facilities in appropriate locations.*

Objective 35 *Minimisation of environmental impacts from the location and operation of waste management facilities.*

It is considered that Objectives 37, 38 and 40 are also applicable to the proposal as they cover issues relating to environmental protection of water resources, control of off-site discharge of stormwater and the handling and storage of hazardous substances.

Environment Protection

Objective 37 *Protection of the quality of water resources and coastal areas from hazardous waste, discharge or storage uses.*

Objective 38 *Control the export of sediment, suspended solids, organic matter, nutrients, bacteria and litter in stormwater run-off.*

Objective 40 *Hazardous substances handled, stored and used with extreme care and appropriate safety precautions.*

In its assessment (section 6 of the Amended EIS) IWS has indicated that Objectives 34 and 35 are satisfied. This is on the basis of the proposal is to be undertaken at the approved balefill site, the design of the proposed new facility, there would be no additional visual impact or noise issues and the proposed environmental management and monitoring provisions.

In its RD the proponent indicated that the proposed design of the facility and stormwater control and management measures included in the LEMP addressed Objectives 37, 38 and 39.

Principles of Development Control

The following principles of development control were considered applicable by IWS (section 6 of Amended EIS), 2, 109, 111, 115, 116, 118 to 128, and 130 to 133:

General Principles

2 *Development should take place in a manner which will not interfere with the effective and proper use of any other land and which will not prevent the attainment of the objectives for that other land.*

Waste Management Principles

109 Waste management facilities should be located, sited, designed and managed to minimise adverse impacts on both the site and surrounding areas due to generation of surface water and ground water pollution, traffic, noise, odours, dust, vermin, weeds, litter, gas and visual impact.

111 Waste management facilities should be provided with appropriate separation distances to minimise adverse impacts on the surrounding area and land uses.

115 Landfill and associated facilities for the handling of waste, should be located at least a distance of 500 metres from the boundaries of the landfill site. A lesser distance may be provided within the land-fill site where the land-fill facility is considered compatible with the surrounding area, land uses and activities so that an effective minimum separation distance of 500 metres can be provided and maintained between the land-fill facility and potentially incompatible land uses and activities.

116 The area of landfill operations on a site should:

(a) be located a minimum distance of 100 metres from any river, creek, inlet, wetland or marine estuarine area and not within the area of a 1 in 100 year flood event; and

(b) not be located on areas with ground slopes of greater than 10 percent except where the site incorporates a disused quarry; and

(c) not be located on land subject to land slipping; and

(d) not be located within three kilometres of an airport used by commercial aircraft. If located closer than three kilometres the land-fill operations should incorporate bird control measures to minimise the risk of bird strikes to aircraft.

118 The waste management site should be landscaped to screen views of the processing facilities and operational areas.

119 Sufficient area should be provided within the waste management site to ensure on-site containment of potential groundwater contaminants and for the diversion of stormwater.

120 Noise reduction treatments comprising separation distances and the incorporation of on-site treatments should be provided to ensure noise generation associated with the waste management operation does not result in an adverse impact to any existing or future development on an adjacent allotment.

121 Litter control measures which minimise the incidence of windblown litter should be provided on the site of a waste management operation.

122 Leachate from waste management activities should be contained within the property boundary of the waste management site and should not contaminate surface water or ground water.

123 A leachate barrier should be provided between the operational areas and the underlying soil and groundwater of organic waste processing operations.

124 The interface between any engineered landfill liner and the natural soil should be:

(a) greater than 15 metres from unconfined aquifers bearing ground water with a water quality of less than 3000 milligrams per litre of total dissolved salts; or

(b) greater than five metres from ground water with a water quality between 3000 milligrams per litre of total dissolved salts and 12 000 milligrams per litre of total dissolved salts; or

(c) greater than two metres from ground water with a water quality exceeding 12 000 milligrams per litre of total dissolved salts.

125 Surface water run-off from the waste management operations should not cause unacceptable sediment loads in receiving waters.

126 Landfill activities that have a total storage capacity exceeding 230 000 cubic metres should sustainably utilise landfill gas emissions. For smaller landfill activities, if the sustainable utilisation of the gas emissions is not practically feasible then controlled flaring is appropriate to avoid gases being vented directly to the air.

127 Fencing to a minimum height of two metres should be erected on the perimeter of a waste management site to prevent access other than at appropriate entries. For landfill sites, the fencing should be of chain wire mesh or pre-coated painted metal construction.

128 Plant, equipment or activities that could cause a potential hazard to the public within a waste management site should be enclosed by a security fence.

130 Waste management sites should be accessed by an appropriately constructed and maintained road.

131 Traffic circulation movements within the waste management site should be adequate in dimension and construction to support all vehicles hauling waste and to enable forward direction entry to and exit from the site.

132 Suitable access for emergency vehicles to and within the waste management site should be provided.

133 A proposal to establish, extend or amend a waste management operation should include an appropriate Environment Management Plan that addresses the following:

(a) The prevention of ground water and surface water contamination;

(b) The need to protect and enhance native vegetation;

(c) Litter control, dust control and sanitary conditions generally;

(d) Odour and noise control;

(e) Fire safety;

(f) Security;

(g) Maintenance of landscaping and the general condition of the site; and

(h) Final contour plan and rehabilitation proposals including soil cover, landscaping, drainage, the removal of any contamination or waste, restoration and the like to ensure compatibility with the surrounding landscape and to enable a suitable after use of the site.

IWS has indicated in section 6 of the Amended EIS that they essentially comply with the above principles of development control.

It is considered that general principles of development control 4 and 5 and environment protection principles 135 to 138 are also applicable.

4 Existing development not consistent with the relevant zone or policy area provisions, should only be altered, extended or intensified within its existing site, if it enhances amenity, safety, health and other environmental conditions on that land and adjacent areas.

5 Development should be of a high standard of design, layout and appearance, and be sited, designed and operated so as to be compatible with and cause minimal impact to, adjoining development and the environment.

Environment Protection

135 Development should be conducted in such a manner as to avoid disturbance or other impact to significant sites and objects of Aboriginal heritage.

136 Building siting, design and construction and the use of land should take place in a manner which:

(a) will minimise interference with biodiversity on the land and in surrounding localities;

(b) will enhance the longer term protection and management of biodiversity;

(c) does not cause coastal erosion, soil erosion or the silting of watercourses, or create any unstable embankment or cutting;

(d) is not liable to contribute significantly to pollution of air, water or land;

(e) will not interfere with the utilization or quality of water resources; and

(f) provides opportunities for maintaining or establishing vegetated corridors to link key areas of native vegetation.

137 Development that is connected to a septic tank or has a low pollution potential should be located at least 50 metres from any watercourse. Development with a high pollution potential should be located at least 100 metres from any watercourse.

138 Waste from any development should be disposed of at least 100 metres from any bore or well.

In the RD IWS concluded that the proposal was not seriously at variance with the additional principles of development control that were relevant to the existing approved use of the site as a waste depot. In particular reference is made to the high level of design of the lining and leachate collection system for the proposal and the management and monitoring provisions indicated in the LEMP.

In terms of Objectives 4 and 5, the following comments are provided. The visual amenity is not altered from the original approved waste depot, as closure will produce the same landform. The design of the facility is of a higher standard than the existing balefill, with management and monitoring measures ensuring that there are no impacts on the environment and adjacent receptor.

The LEMP addresses issues relating to the control and management of soil erosion, air, water and land pollution and potential impact on the quality of water and it is considered that will ensure compliance with principles of development control 136. While groundwater monitoring bores or wells could be located within 100 m of the proposed waste disposal cells, this is not considered to be contrary to principle of development control 138 as its intent is to prevent waste impacting groundwater extraction bores or wells used for human consumption, stock use or irrigation.

General Farming Zone

The following objectives and principles of development control have been indicated by the proponent as been applicable to the proposal.

Objective

Objective 1 *Maintenance of general farming activities and land use on large property holdings.*

Objective 2 *Reinforcement of the existing open rural character of the area.*

Objective 3 *Preservation of features of scenic or environmental significance.*

Principles of Development Control

1 *Development should be primarily for cereal production and livestock grazing on large land holdings with associated buildings.*

2 *Development of a business/commercial or industrial nature should not take place unless it:*

(a) is associated with the processing or handling of primary produce, is for the purpose of organic waste processing and would be of significant benefit to the rural community;

(b) would not cause traffic problems or ribbon development along roads;

(c) would not prejudice the use of the land in the locality for primary production and associated residential use;

(d) would not impair the amenity of the locality;

(e) cannot be accommodated on alternative sites within the defined township, settlement or industrial zones; and

(f) would be more effectively and appropriately located in this zone.

18 *Development involving the reception, storage, treatment or disposal of waste, except for the processing of organic waste, should not occur.*

IWS indicated that as the proposed development is within a land holding that has approval to establish a waste depot, then the proposal is not with the above general farming provisions.

The Development plan establishes a range of developments that are non-complying in the General Farming Zone:

19 *The following kinds of development, including:*

(a) change of use to the listed use;

- *Disposal, treatment and/or storage of contaminated soil and waste referred to in Schedule 2 of the Waste Management Regulations, 1988.*
- *Use of land for the reception, storage, treatment or disposal of waste, except for an organic waste processing facility where …..*

IWS has indicated that the amendment does not propose to establish or develop a new use, but to receive additional waste types in the existing facility.

The proponent has not addressed the issue of disposal and or storage of low level contaminated soil or waste referred to in Schedule 2 of the Waste Management Regulations 1988. *The Waste Management Act 1987* was repealed following proclamation of the Environment Protection Act 2003. A review of the 1988 Regulations indicates that Schedule 2 has been essentially adopted as Schedule 1 in the *Environment Protection Act 2003*. On this basis it could be reasonably

argued that the proposed receipt of LLCS and LTPR is a non-complying activity, were it to be assessed under the normal provisions. However, the proposal seeks to vary the types of wastes received at the currently licensed and operating waste depot. In any event, the non-complying status does not apply to this proposal as it is being assessed as a merit use under the Major Developments provisions of the *Development Act 1993*.

Conclusion

It is concluded that, notwithstanding the "non-complying " nature of the proposed development in the relevant zone, the proposal is not at variance to the Development Plan, provided the potential impacts can be managed appropriately. Sections 5 and 6 of this AAR consider the issues in detail.

3.3 BUILDING RULES

This AAR does not include specific assessment of the proposal against the provisions of the Building Rules under the *Development Act 1993*. If the Governor grants Provisional Development Authorisation, Building Rules certification would be a reserved matter requiring additional approval (pursuant to Regulation 64 of the Development Act 1993) from the Governor or the Development Assessment Commission as delegate of the Governor, following certification by a private certifier or the District Council of Mallala.

3.4 OTHER LEGISLATION

The proposed development involves an activity of major environmental significance as indicated in the *Environment Protection Act 1993* and accordingly was referred to the EPA.

When proposals involve activities of major environmental significance the Governor, before making a decision on the development, must have regard to the objects of the *Environment Protection Act 1993*, the general environmental duty and any relevant environment protection policies.

The objects of the *Environment Protection Act 1993* are:

- *To promote the principles of ecologically sustainable development;*
- *To ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment having regard to the principles of ecologically sustainable development, and to prevent, reduce, minimise and, where practicable, eliminate harm to the environment.*

In addition, proper weight should be given to both long and short term economic, environmental, social and equity considerations in deciding all matters relating to environmental protection, restoration and enhancement. The EPA is required to apply a precautionary approach to the assessment of risk of environmental harm and ensure that all aspects of environmental quality affected by pollution, and waste are considered in decisions relating to the environment.

The EPA provided comment on the Amended EIS (refer to sections 4.3 of this AAR), RD and prepared a final submission (Appendix C).

3.5 OTHER MATTERS FOR CONSIDERATION

The Governor is also required to have regard to any other matters considered relevant. In this context, an assessment has been carried out with reference to the State Strategic Plan. The State Strategic Plan seeks to widen opportunities for all South Australians through the pursuit of six strategic objectives:

- Growing prosperity
- Improving well being
- Attaining sustainability
- Fostering creativity
- Building communities
- Expanding opportunities

Of relevance to the proposal are the objectives of improving well being by improving the quality of life and well being of the community and individual citizens, and attaining sustainability, with the focus being on the protection of biodiversity, sustainable water and energy supplies and minimising waste.

Past industrial practices have resulted in the contamination of land that has the potential to impact the health and well being of the community and individuals. In addition in order to minimise the State's ecological footprint there is an opportunity to redevelop land that has been degraded by contamination for residential use, subject to appropriate clean-up being undertaken. In many instances there are no economically viable technologies to treat the contaminated soils to a level that would enable the effective use of the site for residential purposes. In these cases it would be necessary to dispose of the contaminated soils in appropriately located and designed facilities.

Establishment of an appropriately designed facility within the existing approved landfill site will mean there is no need to develop a new site with potential impacts on biodiversity. The design measures proposed for the LLCS and LTPR cells will provide a high level of environmental protection in terms of potential impacts on water resources.

The waste materials proposed to be disposed at the site are residues from the treatment of industrial liquid wastes, or cannot be economically remediated to remain in-situ at sites proposed for residential use or sites that may pose a risk to human health or the environment.

The establishment of the proposed facility within an existing approved landfill is considered to be appropriate from an environmental perspective and accords with relevant provisions of the State Strategic Plan.

4. CONSULTATION WITH THE PUBLIC, COUNCIL AND GOVERNMENT AGENCIES

The Amended EIS was placed on public exhibition for 3 weeks from 27 August 2003 to 17 September 2003, with 3 submissions received from the public and a submission from the District Council of Mallala. In addition submissions were received from relevant Government Agencies. All submissions were forwarded to IWS, and IWS subsequently prepared a RD (Appendix A) and Supplementary Information (Appendix B).

4.1 PUBLIC SUBMISSIONS

The issues raised in the submissions were analysed and the proponent's responses set out in the RD. Key issues raised were:

- Proposal is not consistent with establishment of a "green, clean community" and may impact the market's perception of the area;
- Proposal not appropriate for a major food production area;
- Proposal not consistent with the District Council of Mallala "General Farming Zone".
- Potential for leakage through the double liner system;
- Potential for the site to destroy important coastal ecology, including samphire, migratory and resident fauna via leachate migration;
- Insufficient information on chemical composition and decay period of contaminated soils and liquid treatment plant residues;
- Undervaluing of agricultural output and economic value to the region, in terms of the intensive animal keeping industry in the area (cattle feedlots, chicken broilers, livestock market, piggeries) and market expectations of a clean green production;
- No assurance that adequate protection from wind blown contaminants and leaching into valuable groundwater supplies;
- Proposal should have undergone a complete new EIS as it was seriously at variance with the essential nature of the original proposal;
- Exacerbation of existing dangerous traffic impacts due to increased volume of waste;
- Clarification sought on the definition of groundwater level and separation distance between the liner and groundwater;
- Undervaluing of groundwater resources in the area and potential for contaminants to be drawn down and impact groundwater sources utilised by livestock producers;
- Proposed groundwater not adequate fro the waste materials proposed to be received;
- Information on the life of the high density polyethylene liner sought and independent review of the proposed lining system;
- Comment on the delay by the proponent in establishing the Local Community Consultative Committee which has not been consistent with original development approval;
- Questions raised on statements made by previous Ministers on receipt of these materials, the need for a sixth waste facility, what happens to existing waste;
- Compatibility of the proposed facility with quality assurance programs currently in place on adjoining intensive livestock production facilities;
- No need for this facility as there exist technologies to manage these wastes.

4.2 DISTRICT COUNCIL OF MALLALA

The District Council of Mallala provided a submission outlining its views on the proposal:

- Paucity of information for the assessment of the potential impacts of groundwater contamination given that all liners leak;
- No details provided in relation to the contaminating substances in soils and treatment plant residues and the reactive potential of combining such chemicals with leachate,
- Assumptions made by applicant on risks of groundwater contamination needs to be rigorously tested to confirm there will be no impact on second aquifer and cause impacts on nearby salt lakes, coastal wetlands which provide habitat for migratory birds and plant species of national and international significance;
- Council questions the results of the an environmental audit of existing operations, groundwater monitoring and formal complaints as reliable indicators of environmental compliance;
- Testing of surface materials in the nearby saline coastal flats is necessary to determine whether contamination has occurred by random movement of suspended particles in water;
- Concern that adjacent intensive animal keeping facilities that cater for local and international markets may be impacted by wind blown emission;
- The LEMP does not specifically address air emissions and in particular the period between disposal and providing a protective cover;
- The proposal alters the essential nature of the current land use;
- Perceived impact of the proposal on the current character of the rural area and would result in a serious detrimental perception of the area as being suitable for primary production;
- The proposal is not consistent with Objective 1 for the "General Farming Zone" and is listed as non-complying form of development;
- The LEMP does not relate to the specifics of the proposal and should be provided;
- Council was also concerned at the apparent arbitrary nature of the adopted consultation process, there is no opportunity for a public hearing for representors or for a personal representation of Council's submission;

4.3 GOVERNMENT AGENCIES

The Environment Portfolio (including the EPA, Department of Environment and Heritage (DEH) and Department of Water, Land and Biodiversity Conservation (DWLBC)), Department of Human Services and Primary Industry and Resources South Australia (PIRSA) were consulted and their comments are included below.

Other Government agencies were not required to provide comment as issues had previously been assessed as part of the original EIS and through the EPA licensing process.

4.3.1 Environment Protection Authority

The EPA indicated that the initial document lacked sufficient information for a proper assessment of the environmental impacts to be undertaken. Specifically the following comments were also provided:

- Additional details for the potential for materials to react and create harmful gases or reaction products and affect workers and adjacent properties;
- Potential for HDPE to be affected by chemicals in the waste materials;
- Potential additional vehicle movements if waste transported in smaller trucks;
- Specific modelling to be undertaken to assess leachate volumes, and seepage potential during operation and closure;
- Insufficient details on the stormwater management measures, design parameters and plans indicating relationships between cells, clean and dirty water, up catchment water and the existing balefill;
- Existing stormwater management measures may not be appropriate or acceptable for the new proposal;
- Details are required, including plans, to confirm that proposed cells have adequate volume for the wastes to be received;
- Additional information on the separation distance between the balefill cells and new cells;
- Compliance required on EPA specification for leachate collection blankets;
- Changes to the geo-composite drainage system was recommended;
- Clarification required on details provided in Figures 210225a-C01, 210225a-C02 and 210225a-C03;
- Amendment to incorrect information in the table of disposal criteria;
- Additional information on the proposed storage of low level contaminated soil and liquid treatment plant residues;
- Assessment of the potential for vapours and odours to impact adjacent land uses and incorporation of management and monitoring measures in the LEMP;
- Modelling to determine the suitability of the proposed cap to ensure that there is no potential for accumulation of leachate as a result of a higher permeability in the cap and resulting in additional leakage;
- The LEMP does not specifically address the proposal and needs to be amended;
- Recirculation of leachate into the existing balefill or the proposed cells is not supported by EPA;
- Monitoring frequency and parameters for assessing groundwater and leachate quality should be based on the nature of the waste materials received and not necessarily the existing monitoring program for the balefill;
- Monitoring and management measures for odours and vapours and treatment or disposal of wheel wash material need to be incorporated in the LEMP.

IWS provided a response to the EPA comments in the RD and through Supplementary Information to clarify design issues.

In its final submission (Appendix C) the EPA indicated it did not oppose the establishment of the LLCS and LTPR facility at the IWS Northern Balefill site and has recommended that if the proposal is approved there are a number of issues that would need to be addressed and included as conditions of any development (refer to section 9 of this AAR and Appendix C). In summary, the EPA provided the following comments:

- The need to maintain a minimum separation distance of 2m at all times between the underside of the lowest portion of the lining system and the underlying groundwater.

- Specific requirements for the leachate collection and extraction system, and management measures.
- Leachate to be treated either by direct pumping to an on-site in purpose built lined leachate storage pond, or extraction directly into liquid waste tanker and then transported to the leachate storage pond, or direct extraction into a liquid waste tanker and then transported off-site to a liquid waste treatment facility.
- A minimum separation distance of 5m to be maintained between the toe of the LLCS and LTPR cells and the balefill cells.
- Construction of the liner to be undertaken under Level 1 Supervision in accordance with AS 3798-1996, Appendix B.
- Construction of the HDPE liner to be carried out under the full time supervision of a suitably qualified geotechnical consultant with experience in the construction and supervision of the construction of HDPE lining systems, quality control procedures and testing.
- The provision of an "As Constructed Report" certifying compliance with the approved design for the lining system and no waste to be received and disposed of prior to written acceptance of the "As Constructed Report" by the EPA.
- All waste must be covered as soon as reasonable practicable after the receipt of waste and placement in the cell or at close of business on each business day with at least 150mm of EPA approved cover material.
- Odorous material to be covered immediately with a minimum of 150mm cover material.
- The need to install and additional groundwater monitoring well and undertake monitoring.
- A stormwater management plan to be developed and submitted for EPA's approval addressing all issues related to the staged construction of LLCS/TPR cells on site prior to commencement of construction of cell 31.
- The LEMP to be upgraded to incorporate a new section dealing with the management of the proposed wastes and submitted to the EPA for approval prior to the receipt and disposal of LLCS and LTPR at the site.

4.3.2 Department of Health

The Environmental Health Service indicated it was supportive of the development proposal in principle and provided the additional comments:

- In order to maintain the EPA August 2000 Guidelines for Separation Distance between neighbouring property and cells, the future cells should be located west of cells 25 and 26.
- Best practice procedures should be observed to minimise the potential for odour problems.
- The facility should be operated so as to prevent the contamination of surface water. Overflow from holding ponds should not be allowed to discharge outside the facility.
- At no time should external surface water mix with internal surface water.
- Any holding pond should be engineered to avoid leakage and prevent the possibility of creating a mosquito breeding habitat.
- Operating conditions should be continually monitored to ensure that dust and odour are minimised to alleviate the potential for nuisance or risk of health beyond the boundaries.

- Close monitoring of wind directions to ensure that dust or microbial emissions are minimised during delivery of LLCS and LTPR.
- Noise control measures should be implemented to ensure that noise levels are consistent with the WHO Guidelines for Community Noise.

4.3.3 Other Agencies

The Department of Environment and Heritage (DEH), Department of Water, Land and Biodiversity Conservation (DWLBC) and Primary Industry and Resources SA (PIRSA) indicated they had no comment on the proposal.

5. ASSESSMENT OF SOCIAL AND ECONOMIC ISSUES

5.1 VISUAL IMPACT

In the original AR it was concluded that progressive rehabilitation and revegetation of the balefill and the establishment of screen plantings around the site perimeter, and possibly adjoining roadside reserves, should adequately mitigate the visual impact of the site. The completed LLCS and LTPR facility will have the same form and height as the balefill cells originally proposed for this area of the site.

It is concluded that establishment of cells to receive LLCS and LTPR will not result in additional visual impact.

5.2 TRANSPORT

The Amended EIS (sections 5.1 and 5.2) states that the LLCS and LTPR is likely to be delivered to the site in 30 tonne trucks resulting in about 670 loads of LLCS per year and 335 loads of LTPR per year. All material would be transported in EPA licensed trucks originating from the Adelaide metropolitan area (section 1.2 and 2.1 of Amended EIS).

The proponent has estimated that there will be less than 1.5% increase in background traffic levels along Port Wakefield Road as a result of the proposed development, and only for short periods of time (section 5.3 of Amended EIS). The RD provided a revised estimate of 1.2% increase if 30 tonne trucks were used.

Following the release of the Amended EIS, a number of respondents raised concerns over potential safety issues associated with increased truck movements. In addition concern was raised by EPA and Planning SA that the number of vehicle movements had been underestimated by IWS.

In the RD, IWS indicated that if smaller trucks were used to transport the material (as opposed to the 30 tonne trucks considered in the Amended EIS) the number of loads would increase from 670 to 1000, resulting in a 1.5% increase in truck movements along Port Wakefield Road.

IWS has provided a wheel washdown area for vehicles at the entrance to the balefill. This wheel wash, while appropriate for the cleaning of trucks transporting waste bales, is not considered suitable for the cleaning of trucks that transport LLCS and LTPR.

It is concluded that the increase in truck movements would not cause a significant impact on the amenity of the area, given the high volumes of traffic currently using Port Wakefield Road. It is further concluded that a wheel wash with an automatic water jetting system should be installed specifically to clean trucks transporting LLCS and LTPR.

5.3 NOISE

As part of its assessment of the original EIS, the EPA was of the opinion that noise levels would comply with the requirements of the *Environment Protection (Industrial Noise) Policy*.

The plant and equipment proposed during construction and operation of the LLCS and LTPR facility are similar to those currently being used at the balefill. IWS is required to undertake noise monitoring, as a condition of its EPA licence, to ensure that noise levels do not result in adverse impacts on the community.

It is concluded that it is unlikely that additional noise impacts will result from the proposed development.

5.4 LITTER

The proposed LLCS and LTPR are not likely to contain any material that would generate litter. In the event that there was litter within the material, it would be managed in accordance with the provisions contained in the balefill LEMP.

It is concluded that there is an acceptable buffer between the proposed activities and the residences to ensure that litter (if present) would not impact adjacent receptors.

5.5 AIR QUALITY

The proposed LLCS and LTPR cells are located 850 m to 900 m from the two nearest residences. The potential for the site to have an impact on adjacent properties is related to the nature of the activity, the distance between the activity and the receptor and climatic conditions.

LLCS and LTPR potentially can contain organic compounds that can generate vapours and odour. In addition the unloading, spreading and compaction of LLCS and cover material has the potential to generate dust. In the public submissions many respondents expressed concerns that there would be deterioration in air quality at nearby residences and potential impacts on health.

The proponent proposes to control and minimise vapour emissions and odour from the LLCS and LTPR cells by:

- regular covering of the waste;
- monitoring and inspection of cover materials for cracks;
- management and monitoring of leachate; and
- monitoring of air emissions at the site boundary.

Dust emissions will be minimised by the controlled application of water.

The proponent undertook odour modelling and the results of the assessment were provided in the RD. It indicated that under the maximum operating surface area a maximum of just above 1 odour unit at the nearest residence (compared to the EPA criterion of 10). Ground level concentrations at the site boundary were also well below the EPA criterion. The EPA has

suggested a condition (should the proposal be approved by the Governor) that requires immediate cover of the LLCS and LTPR if particularly odorous material is received and routine monitoring of odorous gases carried out as part of the site monitoring program.

The Health Services group within the Department of Human Services (now the Department of Health) indicated that appropriate monitoring and management measures should be implemented to ensure that the potential impacts of odour and dust were minimised.

It is concluded that the facility is unlikely to generate unacceptable vapours, odours or dust at the nearest residences and that management measures required by the EPA will mitigate any potential impacts.

5.7 FIRE RISKS AND PREVENTION

The facility is likely to receive soils contaminated with petroleum hydrocarbons that may contain volatile organic compounds. The potential for explosive conditions to occur is considered to be low.

It is concluded that if the Governor grants approval the LEMP should be upgraded to ensure there will be adequate fire safety precautions and control measures, including access tracks to specifically address the LLCS and LTPR facility.

5.8 HERITAGE

Aboriginal heritage and non-aboriginal heritage issues were addressed in the original EIS and prior to commencement of operations. The proponent is required to comply with the requirements of the *Aboriginal Heritage Act 1988.* Any burial sites, skeletal material or significant discovery during development of the site are required to be reported to the Department of Aboriginal Affairs and Reconciliation (DAARE).

5.9 ECONOMIC ISSUES

IWS has indicated it has invested in excess of $15 million for the Northern Balefill and Resource Recovery and Transfer facility at Wingfield (that includes the baling plant).

The direct economic benefit to the local community has not been identified other than to state that the proposal will provide a state of the art facility that will benefit industry and the State.

IWS has established a financial guarantee in accordance with the requirements of the EPA. The funds allocated would cover the liability for the current operation together with ongoing monitoring and post closure program that would be required for each balefill stage. The funds may need to be increased given the proposed waste materials.

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 contamination from air emissions. 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 facility, although no corroborative evidence has been provided. Of note is

that Primary Industry and Resources SA (PIRSA) indicated it had no comment on the proposal by IWS to establish the facility and in its response to the original EIS, PIRSA indicated that the balefill would not have an impact on the adjacent agriculture in terms of pest plants and diseases.

It is concluded that the proposed facility should have no unacceptable economic impact on the use of the adjoining land for agricultural purposes, providing the facility operates in accordance with the LEMP and licence conditions, particularly, in regard to the control of dust and odour and the management of surface and ground waters.

6. ENVIRONMENTAL IMPACTS

6.1 BIOLOGICAL

A Vegetation Management and Revegetation Plan were incorporated in the initial LEMP that was approved by EPA.

The EIS concluded the potential impact on existing native fauna was expected to be minimal. The proposed LLCS and LTPR facility is to be located within the existing waste depot and therefore impacts are also considered to be minimal.

Concerns were expressed in submissions that the proposed facility may pose a risk to coastal and marine ecosystems associated with the Gulf of St. Vincent if seepage from the cells occurred. The risk of contamination of the Gulf via groundwater transmission is considered to be acceptable and manageable given the proposal to establish a double liner (compacted clay and high density polyethylene geomembrane) and leachate collection system.

The management and monitoring of groundwater and surface water would be controlled through conditions of licence imposed by the EPA.

It is concluded that the monitoring of leakage through the double liner system proposed for the development, and the monitoring of groundwater quality down gradient of the disposal cells and within site surface water drainage swales and storage ponds is acceptable for detecting any leaks and enable the implementation of suitable remedial measures (such as interception and extraction by pumping), if required.

6.2 WEEDS AND PEST CONTROL

A Weed and Pest Control Plan has been established as part of the approved LEMP for the balefill, therefore the management measures are considered acceptable.

6.3 SURFACE WATER

IWS has indicated that surface water and drainage management procedures will be adopted as described in the LEMP (section 9.2 of the Amended EIS). These essentially involve, the control and management of surface runoff entering and leaving the site, minimising the amount of contaminated water to be treated as leachate and maintenance of existing water quality.

During construction and lining of the proposed cells, and in the operational phase, stormwater will be diverted around the cells. An overall final site drainage plan was provided in Figure 9.1 of the Amended EIS. The proposed management and monitoring measures have been amended in the RD (Appendix A) and clarified in the Subsequent Information (Appendix B) and essentially involves the following measures.

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 to prevent contact with the waste disposal areas.

Run-off that has not contacted waste material would be collected in drains that would discharge into sedimentation ponds for either evaporation or re-use for dust suppression and irrigation of site vegetation when available. The drains are proposed to be vegetated and capable of dealing with flows from a 1:100 year return interval event and the sedimentation ponds have been designed for a 1:25 ARI, 24 hour storm event capacity. Larger storm events would overflow the ponds and discharge to the external drainage system.

IWS proposes that run-off that has come into contact with LLCS and LTPR would be collected as leachate and treated with other leachate in a dedicated system, separate to that for the balefill. Any runoff originating from the vehicle workshop or wheel washing facility will be contained and treated with the leachate from the LLCS and LTPR facility. Additional specific management measures for the LLCS & LTPR cells were included in the Supplementary Information.

The EPA has advised that a specific stormwater management plan must be developed and approved by the EPA prior to construction commencing and addressing the following:

- surface water or stormwater runoff that does not interact with the waste material or other operational areas of the site and is considered to be uncontaminated
- surface water that comes into contact with waste materials or is collected from landfill areas or other operational areas and is considered to be contaminated
- surface runoff from the final landfill cap which has to be controlled
- surface water runoff from perimeter areas must be diverted from the operating cell

It is concluded that the proposal has provided general principles as to how surface water management will be undertaken but additional information in the form of a stormwater management plan should be prepared (should the Governor approve the proposal) to the reasonable satisfaction of the EPA.

6.4 GROUNDWATER AND LEACHATE MANAGEMENT

The Amended EIS (section 7) indicates there are two groundwater systems beneath the site:

- a shallow groundwater system with salinities of 10,000–40,000 mg/L total dissolve solids, in the top of, and above the Hindmarsh Clay, in lenses in the clays and in sand lenses and layers that are braided into the clays;
- a deeper aquifer that is confined by the Hindmarsh Clay and has salinities ranging from 4,000-7 000 mg/L and is used for irrigation and stock watering.

The design of the LLCS and LTPR cells has been based on monitoring data of groundwater levels at the site. The base of the lining system is proposed to be located 2m above the highest recorded standing water level. In addition an additional buffer of 0.1 m has been included (Supplementary Information). Leachate extracted from the cells could be disposed of by pumping into evaporation ponds that are separate to those for the balefill or into liquid waste tankers for off-site treatment.

The proponent has advised that the optimum location for any leachate evaporation ponds would be determined during the detailed design phase. The proponent has further indicated that the capacity of the leachate evaporation ponds would be the total hydraulic loading (rainfall on the pond plus volume of leachate) balanced with total evaporation on an annual basis. Protection measures would be incorporated to prevent any overflow into the stormwater management system.

IWS has indicated (section 7.2 of the Amended EIS) that there is negligible potential for migration of contaminants from the landfill to the deeper aquifer. The proponent has indicated that any movement of contaminants from the cells (if any) would be extremely slow and controlled primarily by diffusion through the geomembrane and that attenuation could occur by either adsorption onto clay particles in the liner, precipitation through chemical reaction and biodegradation. The proposed LLCS and LTPR cells have a secondary lining and leak detection system to assess the performance of the cells. In the event of fluids being detected there is a mechanism for extraction.

Monitoring of groundwater and leachate levels and careful management of the leachate collection/extraction system would be required to ensure full containment of leachate within the cells.

The EPA has indicated that the proposed facility should be approved subject to conditions relating to the leachate collection and extraction system, monitoring and management measures (refer to section 4.3 and Appendix C of this AR).

It is concluded that the design for the cells, which includes a double lining and leachate collection system provides acceptable safeguards against pollution of the underlying groundwater and potential impacts on the Gulf.

7 MITIGATION, MANAGEMENT AND MONITORING

7.1 LANDFILL ENVIRONMENTAL MANAGEMENT PLAN

The proponent provided a copy of the EPA approved LEMP for the balefill site. However, the LEMP was not adequate, as it did not address issues relating to the LLCS and LTPR facility. At the request of EPA the proponent provided additional subsections specifically dealing with aspects of the LLCS and LTPR cells that would be included in an updated LEMP, if the Governor grants development authorisation.

Many of the potential impacts identified, mitigation and management measures in the current LEMP are applicable to the new proposal. The following additional issues needed to be addressed.

- Upgrading of the financial assurance package due to the increased potential risk as a result of the materials proposed to be received;
- Management and storage of surface water;
- Monitoring (especially of groundwater) and leachate levels;
- Vapour emissions and odour control, both during the operational phase;
- Specific plans and design parameters for separate containment of stormwater and surface water; and
- 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.

In the RD and Supplementary Information the proponent has provided information that is proposed to be included in an amended LEMP.

The EPA has indicated that a revised LEMP incorporating specific management measures for the LLCS and LTPR cells is required (should development approval be granted by the Governor) to be submitted for its approval prior to the receipt and disposal of LLCS and LTPR.

It is concluded that upgrade of the current LEMP is required to ensure that the management and monitoring commitments by IWS are implemented and adhered to.

8. CONCLUSIONS

The amended assessment of the proposal by IWS to receive and dispose LLCS and LTPR at the approved 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 Amended AR as required by the *Development Act 1993* and also as it will be responsible for the determination of licensing requirements if the proposal is granted development authorisation by the Governor.

The Mallala District Council provided a written submission on the proposal and consideration has been given to the relevant Development Plan, government and public comments.

It is concluded that the following issues have been satisfactorily addressed in the Amended EIS, RD, Supplementary Information and proposed amendments to the LEMP to enable the Governor to make a decision on the proposed development.

Consistency with Government Policies

- In its election policy the Government indicated its opposition to any new major landfills. The proposal does not seek to establish a new landfill, but seeks to be able to receive additional waste material not covered by the current development approval, at its approved and licensed balefill site.
- The proposal is generally consistent with the Planning Strategy for Regional South Australia, January 2003.
- The Mallala (DC) Development Plan, Consolidated 30 January 2003, Council Wide waste management objectives 34 and 35 provide for the orderly and economic development of waste management facilities in appropriate locations and minimisation of environmental impacts from the location and operation of waste management facilities, respectively. The proposal is to receive low level contaminated soil and liquid treatment plant residues at the existing approved and licensed balefill site under controlled situations.
- The Development Plan provides council wide principles of development control for waste management facilities and the proposal is generally consistent with these principles.
- The District Council of Mallala has indicated its opposition to the proposal based on, not consistent with the development Plan, insufficient information on the potential impacts on groundwater, insufficient information on management and monitoring measures, impacts on the adjacent intensive animal keeping industry, and insufficient public consultation period.

Social Impacts

- The proposed receipt of LLCS and LTPR at the IWS Northern Balefill would not change the present land use as the site has current development approval and operates as a waste depot.
- The local community has indicated its opposition to the proposal based on, impacts to the local economy, proposal not consistent with the Development Plan, proposal not

appropriate for a major food production area and market perceptions, the potential impact of fugitive emissions, impacts on groundwater and the coastal area.

- An adequate buffer area is present to minimise the potential impacts on adjacent residents and other land uses. The closest dwelling to the site is presently 800m from the nearest portion of the proposed LLCS and LTPR cells.
- Volatile emissions, odour generation and dust emission would be managed and mitigated according to provisions in the LEMP and as part of licence conditions imposed by the EPA. Modelling undertaken by IWS indicates that odour emission levels and concentrations of volatile organic compounds at the site boundary and the nearest residences are below the EPA criterion.
- Establishment of the facility at the IWS balefill would provide a repository that would cater for the northern metropolitan area and minimise the transport of materials through metropolitan Adelaide.
- Establishment of the facility will not change the visual impact of the approved Northern Balefill.

Traffic

- The projected increase in traffic above existing levels (1.5%) is considered to not be significant in terms to the existing traffic movements along Port Wakefield Road.

Heritage

- There are no Aboriginal and non-Aboriginal heritage issues that were not already considered as part of the original EIS.

Economic Issues

- The proposal is not expected to detrimentally affect the existing primary industry based, economic viability of the region.

- The current Financial Assurance Strategy should be upgraded to take into consideration the additional waste material proposed to be received at the site and dealt with under relevant provisions of the Environment Protection Act 1993.

Biological Issues

- The proposal will have no additional potential impacts on native flora and fauna.
- There are not likely to be any additional impacts associated with weeds and vermin due to the nature of the waste materials proposed to be received.

Stormwater Management

- The EPA requires a Stormwater Management Plan to be prepared prior to commencement of construction activities, if development approval is granted to the proposal.

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 geological conditions and near surface aquifer systems are continuous beneath and beyond the site. However, the proposal to construct a double liner and leachate collection system provides acceptable safeguards against pollution of the underlying groundwater and potential impacts on the Gulf.
- The installation of the compacted clay liner and HDPE geomembrane should be undertaken under full time supervision by a geotechnical engineer under a Quality Assurance plan acceptable to the EPA.
- Monitoring of groundwater and leachate levels and careful management of the leachate collection/extraction system would be required to ensure hydraulic containment of this leachate.

9. RECOMMENDATIONS

This Amendment to the Assessment Report concludes that the impacts associated with the proposed receipt of Low Level Contaminated Soil and Liquid Treatment Plant Residues at the IWS Northern Balefill Site from environmental, social and economic perspectives are acceptable and manageable.

If the Governor were to grant development authorisation, the current development authorisation will need to be amended and additional conditions should be based on the following requirements:

1. Integrated Waste Services shall undertake the development in accordance with the Amended EIS or as amended by the Response Document and Supplement Information.

2. Distance to groundwater
   - Based on groundwater level monitoring results and interpolated highest groundwater levels for Cell 31, including a 0.1m buffer, the base of the sump shall be at 9.1mAHD;
   - Not withstanding the above, a minimum separation distance of 2m between the underside of the lowest portion of the lining system (including the sump area) and the underlying groundwater shall be maintained at all times.

3. Leachate collection and extraction system:
   - Both leachate collection pipes shall:
     - have a minimum diameter of 180mm (reference drawing 3307D01) with a 1m radius bend
     - extend into a solid riser pipe on the eastern and western batter slopes (without any penetration of the lining system)
     - be accessible for flushing at any time
     - extend into the leachate extraction pipe.
   - Leachate removal shall implement a system which accommodates the installation of the pumps at the leachate riser access point.
   - Following cell completion and until the entire cell base is covered with a minimum of 1.5m of waste, a pump with a flow capacity of a minimum of 40 litres per second shall be installed.
   - After it can be demonstrated that leachate production has declined to less than 1 litre per second, this pump can be replaced by a pump of lesser flow capacity.
   - A back-up pump with the relevant capacity shall be readily available on site at all time.

4. Leachate treatment
   - Leachate can be managed and treated by means of:
     - direct extraction into an on-site leachate evaporation pond which shall meet the minimum design specification as follows:
       - composite lining system comprising a 1m low permeability clay liner with k < 1x 10^{-9}m/s compacted to 95% Maximum Dry Density by standard compaction, and a moisture content between 0 and +4% wet of Optimum Moisture Content, overlaid by a 2mm HDPE liner (welded)
       - minimum of 600mm freeboard
       - modelling with HELP or LANDSIM shall consider a 1 in 25, 24h duration storm event
       - a minimum separation distance of 2m between the underside of the lowest portion of the lining system and the underlying groundwater must be maintained at all times.
     - Direct extraction into an onsite tank vehicle suitable for the transport of leachate into an onsite leachate evaporation pond
     - Direct extraction into a licensed vehicle and transported to an off site EPA licensed Waste Water Treatment Plant
     - Direct extraction into a suitably designed, temporary on-site storage tank prior to off-site disposal by a EPA licensed vehicle at an EPA licensed Waste Water Treatment Plant or prior to on-site transport to an onsite leachate evaporation pond.

5 Leachate management
   - A maximum leachate head of 300mm shall be maintained on top of the liner (excluding the sump) at all times. To facilitate this the trigger level for leachate extraction out of the leachate sump shall be set at 290mm
   - In addition to automatic leachate data readings a manual monitoring probe shall be installed and calibrated to allow for direct readings of the vertical elevation of leachate in the riser pipe and conversion to the maximum leachate head on top of the liner
   - Leachate levels shall be read manually daily and recorded in the onsite operations logbook or as specified otherwise in the EPA licence.

6 Distance between LLCS/LTPR Cell and Balefill cell (reference drawing 3307D03)
   - The distance between LLCS/LTPR and Balefill cells shall be at a minimum of 5m, measured between the toe of the LLCS cell structure (that is where the outer surface of the cap of the completed LLCS/LTPR cell joins the outer surface of the underlying clay liner for the same cell) and the cap of the nearest balefill cell (that is where the outer surface of the cap of a completed balefill cell joins the outer surface of the underlying clay liner).

7 Level 1 supervision
   - The construction of the clay liner of the cell shall be carried out under Level 1 Supervision in accordance with AS 3798-1996, Appendix B.
   - The construction of the HDPE liner shall be carried out under the full time supervision of a suitably qualified geotechnical consultant with experience in the

construction and supervision of the construction of HDPE lining systems, quality control procedures and testing.

8. "As Constructed Report"
   - An "As Constructed Report" certifying compliance with the approved design for the lining system, including a Construction Quality Assurance Report (CQA) for the HDPE liner and the Level 1 Supervision Report, shall be submitted to the EPA for acceptance prior to the commencement of receival and disposal of waste in the cell. No waste shall be received and disposed of prior to written acceptance of the "As Constructed Report" by the EPA.

9. Coverage of waste
   - All waste shall be covered as soon as reasonable practicable after the receipt of waste and placement in the cell or at close of business on each business day with at least 150mm of cover material (waste fill or intermediate landfill cover with the restriction to a maximum particle size of 100mm).
   - If a load of particularly odorous material is received at the LLCS/LTPR cell, it shall be covered immediately with a minimum of 150mm cover material.
   - During periods when the LLCS/LTPR cell is not operating, routine monitoring for odorous gases shall be carried out as part of the site monitoring program and may trigger the application of additional cover material.
   - Alternative cover materials may be used after the licensee:
     - has demonstrated that the proposed material and placement method result in an equivalent or better performance compared to the approved material; and
     - has received written approval from the EPA prior to the use of alternative materials and placement methods.

10 Groundwater management
   - An additional groundwater well shall be installed west of cell 30 and the first round of groundwater sampling and testing shall be completed at least 2 weeks prior to commencement of construction of cell 31
   - Groundwater level monitoring shall commence at least 2 weeks before commencement of construction of cell 31; groundwater levels shall be taken weekly and reported to the EPA monthly (datasheet and graph) or as specified otherwise in the EPA licence
   - Four monitoring rounds at three monthly intervals in the first 12 months of operation shall be carried out to establish additional background analyte levels around cell 31
   - Six monthly monitoring rounds shall be undertaken following the completion of the initial 12 months of groundwater monitoring or as specified otherwise in the EPA licence
   - Prior to the commencement of construction of any other cell for the receipt of LLCS/LTPR, the groundwater management and monitoring program shall be reviewed and submitted for EPA approval.

11 Surface Water Management
   - A stormwater management plan shall be developed and submitted for EPA's approval addressing all issues related to the staged construction of LLCS/LTPR cells on site prior to commencement of construction of cell 31

- The stormwater management plan shall provide surface water control and management measures for:
    - surface water or stormwater runoff that does not interact with the waste material or other operational areas of the site and is considered to be uncontaminated
    - surface water that comes into contact with waste materials or is collected from landfill areas or other operational areas and is considered to be contaminated
    - surface runoff from the final landfill cap which has to be controlled
    - surface water runoff from perimeter areas shall be diverted from the operating cell.

12 LEMP

- The new section of the LEMP (‘Section 17’) shall be completed following the development approval and incorporated in the revised LEMP document
- The complete revised LEMP document shall be finalised and submitted to the EPA for approval prior to the receipt and disposal of LLCS/LTPR on the premises.

10. REFERENCES

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11. GLOSSARY

AHD	Australian Height Datum (approximate mean sea level)
AS	Australian Standard
CFS	Country Fire Services
DB	Decibels
DAARE	Department of Aboriginal Affairs and Reconciliation
DHS	Department of Human Services
DTUP	Department for Transport and Urban Planning
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	Environment Protection Authority
HDPE	High density polyethylene
LCCC	Local Community Consultative Committee
LEMP	Landfill Environmental Management Plan
LLCS	Low level contaminated soil
LTPR	Liquid treatment plant residues
L/s	Litres per second
m	Metres
mg/L	Milligrams per litre
NATA	National Association of Testing Authorities
PIRSA	Primary Industries and Resources SA

APPENDIX A

RESPONSE DOCUMENT

Response Document on the EIS Amendment for the Receipt of Low Level Contaminated Soil and Liquid Treatment Plant Residues (Revised)

30 April 2004

IWS Northern Balefill

2001, 2002, 2003
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Date: April 2004.....

Distribution: SA Govt (5), PB (3), IWS (3).....

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Contents

Appendices

1. Introduction

In July 2003, Integrated Waste Services Pty Ltd (IWS) lodged an application to amend the Development Authorisation and Environment Protection Act License for their operations at the Northern Balefill site. This application was undertaken as an amendment to the existing Environmental Impact Statement (EIS) under Section 47 of the *Development Act 1993*.

The proposed amendment to the EIS was to permit the receipt of additional materials into the Balefill as outlined below:

- Low Level Contaminated Soil (LLCS) – soil with levels of contaminant previously defined in EPA Bulletin No. 5 (typically from commercial and industrial sites); and

- Liquid Treatment Plant Residues (LTPR) – solid residues left over from a dewatering process in the treatment of liquid wastes, typically from centrifuge or filter press processing. The material is moist and clay-like in texture (no free water) and spadable.

In accordance with Section 47 of the *Development Act 1993*, the application is under assessment by Planning SA and has been the subject of consultation with government agencies, relevant stakeholders and the general public.

Submissions were received from 7 government agencies, although four of these submissions declared there was no comment from their agency. Three submissions were received from the public. The response to these submissions is provided in Sections 2 to 7 of this document.

This response document should be read in conjunction with the *EIS Amendment: Receipt of Low Level Contaminated Soil and Liquid Treatment Plant Residues at the IWS Northern Balefill* (July 2003).

2. Response to Comments - Planning SA

The Planning SA submission was introduced as follows: …"This submission is based on a review of the document titled EIS Amendment: Receipt of Low Level Contaminated Soil and Liquid Treatment Plant Residues at the IWS Northern Balefill, dated 11 July 2003. The document also includes the Landfill Environmental Management Plan dated August 2001.

In order for the Governor to make an informed decision on the proposal there has to be sufficient information on the proposed development, the potential impacts and how such impacts are to be addressed.

Following a review of the above documents, Planning SA seeks additional information and clarification on a number of issues as detailed below."

2.1 EIS Amendment Document

(a) Comment: The proposal essentially involves the disposal of low level contaminated soil and liquid treatment plant residues into specifically engineered landfill cells at the currently operating IWS balefill near Dublin. The material will have a range of chemicals that could result in chemical reactions that may generate adverse vapours and gases and bi-products that are either more toxic or mobile than the individual constituents. Additional information is required on QA/QC and monitoring and management measures that will be adopted to ensure that there are no adverse impacts on human health and the environment, both on-site and off-site.

Response: While the exact constitution of the material to be received at the landfill is not known, it will, as a minimum, be required to be meet criteria shown in Appendix A. These criteria are similar to those applicable to Southern Waste Pty Ltd. Where an LTPR to be placed in the LLCS/LTPR cell contains an analyte with no specified criteria in Appendix A, it will be required to meet the LLCS soil criteria.

Waste will only be received by the low level cell by prior arrangement, and where supporting documentation is provided. This will include NATA certified analytical results. All waste will be accompanied by EPA Waste Tracking Form.

In order to minimise the potential to for the generation of toxic gases, LLCS or LTPR wastes received on any given day containing significantly different analytes will be placed in different parts of the Cell to minimise potential direct contact. Odorous materials will be covered with day cover as soon as practical after receipt to reduce emissions. There will be no mixing of wastes containing significantly different contaminants at any time.

All LLCS or LTPR received to the cell will be covered by close of business each day with approximately 150mm of day cover. This will assist in reducing contact between soils and residues from differing sources, and minimising the discharge of odours.

Ausplume air dispersion modelling has been undertaken to predict the "worst case" ground level concentrations of odour (see Report in Appendix B). The outcomes of the modelling were compared against the EPA Guidelines. This assessment shows that the acceptance of LLCS and LTPR will not pose a risk to the nearest sensitive receptors in terms of odour generation from air dispersion.

Monitoring and management of odours from the LLCS cell are discussed below (Section will be incorporated in the revised LEMP. The proposed additional LEMP chapter relating to the LLCS cell is provided in Appendix C.

(b) Comment: Additional technical information on the 1.5 mm HDPE geomembrane is required that indicates it will not be negatively impacted by chemicals present in the low level contaminated soil and liquid treatment plant residues.

Response: Additional information on the chemical resistance of HDPE geomembranes is contained in Appendix D. Additional protection is to be provided by specifying a geotextile protector made from polypropylene to provide improved strength over polyethylene and to ensure the contaminated soils do not come into direct contact with the geomembrane. Polypropylene provides equal protection chemically as polyethylene products, the difference being polypropylene resin/fibres are stronger.

(c) Comment: It is indicated in Section 5 of the EIS Amendment that LLCS and LTPR would be transported to the site in trucks with a 30 tonne capacity.

Discussion with remediation contractors has indicated that lesser weight trucks are used for remediation (15-24 tonne) due to site access limitations and the potential for large soil clumps and fill material (that typically occurs on contaminated sites) to damage the thin trailer “skins” of existing 30 tonne trucks.

If this is the case use of trucks with a smaller capacity will result in increased vehicle movements than indicated in the document.

Response: Should smaller trucks be used the traffic volumes will be greater. For instance, assuming an estimate of 20,000 tonnes of LLCS per annum, if 20 tonne trucks are used this would equate to 1,000 loads compared with 670 loads for 30 tonne trucks. However, the traffic impact assessment indicates that the increase in background traffic levels due to the use of smaller trucks will be of a similar order to using trucks with 30 tonne capacity, that is, approximately 1.5% (compared with 1.2%) increase on the existing traffic volume. It is expected that in the case of using trucks of lesser capacity, the period of movements will occur over a greater number of days.

(d) Comment: Section 8 of the EIS Amendment provides details of the proposed lining system for the site. The suitability of the concept design and assessment of the potential risk of contamination of groundwater below the site has not been carried out.

Planning SA is of the view that calculation of the volume of leachate and potential seepage through the lining system should be undertaken using currently accepted modelling techniques (eg HELP, LandSim). The design of the drainage material, collection pipes and leachate collection ponds should be based on this information. Modelling should be carried out for a range of scenarios, including, operation and following capping.

Response: HELP modelling has been carried out and a detailed report is in Appendix E. The HELP model indicates that leakage from the landfill is not considered to be a significant risk to groundwater.

(e) Comment: Section 9.2 provides an overview of surface water management measures and refers to provisions in the Landfill Environmental Management Plan (LEMP) and includes a plan of post closure management. The information provided is insufficient to enable a proper assessment of the surface water management and control measures for the specific proposal to receive LLCS and LTPR.

This information should clearly detail how it is proposed to manage clean and contaminated stormwater for the following: within each cell, between cells and between the balefill and the new proposed cells. Additional information (including plans and cross sections) is also required on the sizing of the stormwater ponds and their locations, up catchment diversion drains and in cell storage areas.

Response: Section 7 of the existing LEMP details the surface water and drainage management procedures for the entire site. A revised surface water management plan, including a concept drainage drawing, has been prepared and is attached in Appendix F. Detailed design of the stormwater drainage system will be included in detailed cell design to be submitted to the EPA for endorsement prior to cell construction.

Following approval of this proposal, the LEMP will be revised to take into account the commitments made in the EIS amendment and associated documents, and submitted to EPA for approval prior to commencing the proposal (see also Appendix C for a draft additional LEMP chapter).

(f) Comment: Section 9.3 provides information on air quality and noise issues associated with the proposal.

Contaminated LLCS and LTPR would be expected to have chemicals that may emit vapours and odours.

There is insufficient information to confirm that odours and vapours from the site will not impact the adjacent landowners. A more detailed assessment should be undertaken, which may include odour modelling in accordance with EPA guideline *Odour Assessment Using Odour Source Modelling, September 2003* (formerly Technical Bulletin No. 25).

Appropriate management and monitoring measures will need to be included in the LEMP to ensure there are no adverse impacts on-site and off-site.

Response: Air dispersion modelling has been undertaken using Ausplume to predict the "worst case" ground level concentrations of odour (see Report in Appendix B). The outcomes of the modelling were compared against the EPA Guidelines. It is clear from this assessment that the acceptance of LLCS and LTPR will not pose a risk to the nearest sensitive receptors in terms of odour generation from air dispersion. An assessment of potential noise impacts from the landfill was undertaken in 2002 and found that operations were well within the EPA's criteria for noise. As a result, IWS were granted permission by the EPA to extend their operating hours.

As this proposal will not change the nature of the operations, it is suggested that the same noise levels will apply and there will be no increased impact on surrounding properties. A complaints register is already in place to deal with air quality and noise issues external to the site.

(g) Comment: In Section 10 the proponent indicates that closure will be carried out in accordance with the cap design approved for the existing balefill.

Appropriate assessment should be undertaken using currently accepted models (eg. HELP, LandSim) to ensure that the proposed cap is appropriate for the cells receiving LLCS and LTPR. On initial observation the proposed cap is of higher permeability than the base liner and is likely to result in greater infiltration and accumulation of leachate following closure, with potential for greater leakage through the lining system.

Response: As stated above, the HELP modelling undertaken for the site indicated that the risk of potential impact to groundwater was not considered significant. This modelling took into account the proposed lining and capping system. See Appendix E for further detail on the methods, data and assumptions used in creating the model.

2.2 Landfill Environmental Management Plan

(a) Comment: The LEMP included in the EIS Amendment was developed for the currently approved balefill and does not contain specific management and monitoring measures that relate to the receipt of LLCS and LTPR.

Response: Following approval, the current LEMP will be revised to take into account commitments made in the EIS amendment and response document and required by the amended site approval. This will include the addition of Appendix C to the revised LEMP.

(b) Comment: Leachate from the balefill facility is proposed to be recycled into the waste material. This technique provides for the attenuation of chemical compounds and assists in faster degradation of the putrescible material, quicker landfill gas generation and potentially a decreased life span for the landfill.

The elevated concentrations of heavy metals, cyanides and organic compounds likely to be present in the leachate may inhibit the microbial degradation of the domestic waste if this leachate is disposed of in the balefill and therefore should not be undertaken.

Similarly the recirculation of leachate into the LLCS and LTPR cells is not considered appropriate given the predominance of clay material in contaminated soils in Adelaide and hence the expected difficulty in assimilating leachate within the soil mass.

Response: It is proposed to establish a hierarchical approach to leachate management from the LLCS Cells.

During the spring, summer and autumn periods, when evaporation generally exceeds precipitation, it is proposed the leachate be recirculated over an operating LLCS Cell. The bulk of what is expected to be a relatively low level of liquid is expected to be lost to evaporation, with some seeping into the cell contents.

Should leachate need to be removed from the cells during winter, consideration will first be given to recirculating leachate over an operating LLCS Cell for evaporation and infiltration. If the LLCS is too wet to absorb the leachate, then leachate will be disposed to a Licensed Liquid Waste Treatment Plant.

If leachate recirculation is not accepted, leachate will be analysed and either disposed off-site to Licensed Liquid Waste Treatment Plant, or an evaporation basin may be constructed to dispose of leachate. Separate approval would be sought from EPA to install this basin, with the basin to be designed to a mutually agreed capacity. If onsite disposal to a leachate pond is undertaken, leachate will not be analysed prior to placement in the pond.

(c) Comment: In order to ensure that the proposed double lining system functions as designed and minimises the potential for seepage and groundwater contamination, supervision of construction should be in accordance with Level 1 Supervision as outlined in Australian Standard AS 4459-1996 *Guidelines for Earthworks for Commercial and Residential Developments*.

The final design of the lining system and supervision of construction should be undertaken by a geotechnical engineering consultant with expertise in compaction control and testing and QA/QC requirements for HDPE liners. At the completion of liner and cap construction, a geotechnical engineer should provide certification that the works have been undertaken in accordance with the design.

Response: Supervision of construction will be undertaken in accordance supervision of construction should be in accordance with Level 1 Supervision as outlined in Australian Standard AS 4459-1996 *Guidelines for Earthworks for Commercial and Residential Developments*.

The final design of the lining system and supervision of construction will be undertaken by a suitably experienced geotechnical engineer. The QA/QC requirements for the clay and HDPE liner are detailed in Appendix G. A report shall be prepared on completion of construction of the liner and the cap certifying that the works have been undertaken in accordance with the design.

(d) Comment: The lining system for the leachate storage pond(s) should be to the same standard as the cells.

Response: No separate leachate storage ponds are proposed in this application.

(e) Comment: The proposed monitoring program is based on the current program for the balefill. The LLCS and LTPR will have greater variety and higher concentrations of chemicals than would be present in the currently accepted waste. On this basis, it is considered that a specific groundwater and leachate monitoring program (including frequency) should be developed that is consistent with the chemical composition of the material proposed to be received.

Response: Volatile Organic Compounds (VOCs), as a standard laboratory scan, are a proposed addition to leachate and nearby groundwater monitoring associated with the proposed low-level cells.

VOCs will be included in ongoing chemical analyses of leachate, which are currently required on a six-monthly basis.

For the relevant groundwater wells, VOC analysis of sampled groundwater is proposed to be included in addition to the current analytical suite as a minimum for the first year to establish background concentrations (if detectable). Following this period, wells will be sampled and analysed for trigger parameters, i.e.

- pH, EC, TDS by EC.
- Cations; Na, K.
- Nutrients; TKN (total Kjeldahl Nitrogen), Nitrate, Nitrite, Ammonia.
- TOC, BOD (total and biological oxygen demand).
- Selected Metals (Cd, Cr, Cu, Fe, Pb, Hg, Ni, Zn).

If the initial or ongoing analysis of LLCS/LTPR cell leachate shows that one or several VOCs are present in significant quantities, then those individual VOCs (or a full scan if no cost savings are available to analyse individual VOCs) would be added to the trigger parameter list for the affected wells.

Under the current groundwater regime, existing wells GW3 and GW4 are upgradient of the low-level cell location, and GW5 is downgradient. As the area being dewatered for

conventional balefill cells shifts, groundwater flow beneath the planned low-level cells may revert to the original southwesterly direction. An additional groundwater monitoring well (marked 'potential new monitoring bore' in Appendix I, Figure I-4) will be installed and sampled prior to construction of the LLCS/LTPR cells. Further details are given in Appendix C, Section XX.2.3.

(f) Comment: As indicated above in the review of Section 9.3, monitoring and management measures for odours and potentially toxic vapours will need to be included in the LEMP.

Response: Vapour and gas generation has been modelled (Appendix B). Monitoring and management measures have been included in the proposed LEMP chapter shown in Appendix C.

(g) Comment: Additional information is required on the control and management of contaminated water and sediment from the wheel wash facility.

Response: An additional wheel wash facility of similar design to the existing facility will be constructed adjacent to the low level cells to clean the wheels of the waste transfer vehicles before they leave the environs of the low level cells.

Sediment from this wheel wash facility will periodically will be removed for disposal to the active low level cell. Water from the wheel wash will be used for dust suppression on the operating LLCS Cell, or disposed to a Licenced Treatment Facility.

3. Response to Comments - Department of Primary Industry and Resources SA

PIRSA has no comment on the proposal.

4. Response to Comments - Environment Protection Authority

The Environment Protection Authority (EPA) response is on behalf of the Environment and Conservation portfolio which incorporates the EPA, the Department for Environment and Heritage, the Department of Water Land and Biodiversity Conservation and ZeroWaste SA.

4.1 Environment Protection Authority

(a) Comment: The EPA has assessed the amended EIS prepared for the proposal and considers that the document lacks sufficient information for a proper assessment of the environmental impacts to be undertaken. Based on the information contained in the amended EIS, the EPA considers the risk of environmental harm cannot be discounted. Consequently it is recommended that approval be withheld at this stage pending the provision of further information by the proponent as detailed below.

Response: Further detail is provided whin this document. It is proposed that the current LEMP be added to and amended as outlined in Appendices C and F once approval is granted.

(b) Comment: The amended EIS indicates that Cell 31 will be dedicated to the receipt of LLCS and LTPR and indicates an option to utilise Cells 30, 25 and 26 at a later stage if required. It is recommended that Cells 31, 30, 25 and 26 be dedicated exclusively for the storage of LLCS and LTPR in order to avoid any adverse impacts with the progressive development of balefill cells in close proximity to LLCS and LTPR cells.

Response: This is the proposed method of development, subject to approval being granted, and such commercial decisions as may be made on the future development of the site.

(c) Comment: It is also recommended that a section for inclusion in the current LEMP should be prepared by the proponent and forwarded to the EPA with the additional information requested below. The new section should demonstrate how the proposed development will be operated, managed and maintained and should address, in particular, the site groundwater and surface water monitoring and management regimes in the context of the overall site management. Additional LEMP requirements follow.

Response: This section has been prepared, and is included as Appendix C. It contains the proposed methodology for the operation, management and maintenance of the LLCS & LTPR Cell, and references operational, management and maintenance activities currently undertaken for the balefill, and which would be extended to include the LLCS cells. It includes reference to amendments to the site management and monitoring regimes.

(d) Comment: The following additional information is requested:

1. Details of the potential for the material to react and create harmful gases or reaction products, and affect workers or adjacent receptors.

2. Confirmation that the proposed 1.5 mm HDPE membrane will be resistant to the chemicals in the waste materials.

3. Section 4.2.2 refers to LTPR that have been rendered inert by processing and fixation and disposed of in accordance with EPA nominated chemical testing and leachability criteria. It is noted that the leachability criteria for treatment plant residues indicated in (former) Appendix F relates to concentrations and leachability criteria for metals. Treatment plant residues are likely to contain a range of chemicals including petroleum hydrocarbons, solvents, pesticides and chlorinated organic compounds. A more comprehensive range of chemicals that are likely to be in treatment plant residues will be required to be tested if development approval is granted.

4. Section 5.2 provides an assessment of transport issues and is based on an assumption that 30 tonne trucks would be used to transport LLCS and LTPR. It is understood that typically 15 - 24 tonne trucks are used for remediation. On this basis the IWS assessment would underestimate the number of truck movements for the site, potentially, by half. Clarification of this matter is requested.

5. It is considered that specific modelling is required (HELP or another approved method) to confirm the expected leachate volumes and seepage generated during operation and closure and hence the design assumptions for leachate collections, drains, sumps and pumps.

6. There is insufficient information in Section 9.2 relating to surface water management issues for the new cells and how these interrelate to each other and the existing management measures. In particular, information is required on the design assumptions/parameters, catchment areas and sizing of ponds and drains, plans and cross-sections of drains and storage ponds is required.

7. Section 9.3 Air Quality: Additional information is required through appropriate modelling / assessment that there will not be unacceptable concentrations of vapour and odours at the site boundary or potential receptors due to emissions from the cells. Management and monitoring measures must be included in the LEMP.

8. Section 10 Post Closure Management: It is indicated that the cap for LLCS and LTPR cells will be the same as for the balefill. As the double liner system will have significantly lower permeability than the proposed cap, there is potential for water infiltration to result in greater accumulation of leachate resulting in a higher head within the cells.

   Appropriate modelling should be undertaken to confirm that leachate does not accumulate in the cell resulting in the “bath tub” effect. Specific details should be provided on the final/revised cap and post closure management, as issues relevant to the LLCS and LTPR are considered to be different to that indicated for the balefill component.

Response:

1. While the exact constitution of the material to be received at the landfill is not known, it will, as a minimum, be required to be meet criteria shown in Appendix A. These criteria are similar to those applicable to Southern Waste Pty Ltd. Where an LTPR to be placed in the LLCS/LTPR cell contains an analyte with no specified criteria in Appendix A, it will be required to meet the LLCS soil criteria.

Waste will only be received by the low level cell by prior arrangement, and where supporting documentation is provided. This will include NATA certified analytical results. All waste will be accompanied by EPA Waste Tracking Forms.

In order to minimise the potential to for the generation of toxic gases, LLCS or LTPR wastes received on any given day containing significantly different analytes will be placed in different parts of the Cell to minimise potential direct contact. Odorous materials will be covered with day cover as soon as practical after receipt to reduce emissions. There will be no mixing of wastes containing significantly different contaminants at any time.

All LLCS or LTPR received to the cell will be covered by close of business each day with approximately 150mm of day cover. This will assist in reducing contact between soils and residues from differing sources, and minimising the discharge of odours or gases.

During operations in a LLCS Cell, potentially hazardous volatile organic compounds will be monitored using a landfill gas monitor or similar. Should monitoring indicate exceedance of trigger values, work will cease in the Cell, and the vapour will be allowed to dissipate before work in the Cell recommences.

Should operations be required to cease in the operating cell, monitoring will be undertaken at the down-wind landfill boundary to confirm the vapour concentration is less than the trigger value.

Should a load of particularly odorous material be received at the LLCS Cell, it will be buried immediately under day cover to minimise the impact to site workers and the possibility of the odour impacting the nearest sensitive receptors.

Routine air monitoring is a requirement of the current approved LEMP. Routine monitoring for odours and gases will be extended to the LLCS Cells, and may include gas monitoring using a landfill gas monitor or similar.

Ausplume air dispersion modelling has been undertaken to predict the “worst case” ground level concentrations of odour (see modelling report in Appendix B). The outcomes of the modelling were compared against the EPA Guidelines. This assessment shows that the acceptance of LLCS and LTPR will not pose a risk to the nearest sensitive receptors in terms of odour generation from air dispersion.

2. Additional technical data on the geomembrane has been provided in Appendix D to demonstrate that there is unlikely to be an impact on the membrane by the chemicals in the waste. The liner system of the cell will incorporate a double clay liner system as shown in Appendix H. The QA requirements for the clay liner and the HDPE liner are shown in Appendix G.

3. The list of leachability criteria for LTPR to be received at the site is shown in Appendix A, and has been amended. Any analyte where a criterion is not shown will be required to meet LLCS criteria.

   There are only two licensed Liquid Treatment plants in South Australia, namely Cleanaway, at George Street Wingfield and Collex at Churchill Road, Kilburn.

   LTPR is the solid by-product of the treatment process of industrial liquid wastes, from either a centrifuge or filterpress dewatering process at the end of the liquid

waste treatment process, or from mixed wastes stiffened by mixing with soil and greenwaste. This material contains the removed immobilised contaminants from liquid oily water, acid/alkali or greasetrap waste streams. These residues have been rendered "inert" by processing and fixation. The material is solid in nature and meets the landfill definition of solid waste in terms of moisture content (i.e. no free liquid) and stiffness (i.e. spadable, able to be handled by a spade).

This by-product residue is routinely tested by a NATA accredited laboratory prior to disposal to ensure its compliance with nominated EPA leachability and landfill criteria. This is a licence condition at both liquid treatment facilities. LTPR will not be accepted for disposal at the Northern Balefill unless it meets analytical criteria shown in Appendix A.

Only licensed vehicles from Cleanaway and Collex transport this material. This is performed in strict compliance with the EPA waste transport codes and requirements, including documentation of every load through a Waste Tracking Form.

Therefore only tested and approved liquid treatment plant residue will be received at the site.

4. Should smaller trucks be used the traffic volumes will be greater. For instance, assuming an estimate of 20,000 tonnes of LLCS per annum, if 20 tonne trucks are used this would equate to 1,000 loads compared with 670 loads for 30 tonne trucks. However, the traffic impact assessment indicates that the increase in background traffic levels due to the use of smaller trucks will be of a similar order to using trucks with 30 tonne capacity, that is, approximately 1.5% (compared with 1.2%) increase on the existing traffic volume. It is expected that in the case of using trucks of lesser capacity, the period of movements will occur over a greater number of days.

5. HELP modelling has been carried out and a report is included in Appendix E.

6. Section 7 of the current approved LEMP details the surface water and drainage management procedures for the entire site.

   The proposed alteration of the use of Cells 31, 30, 25 and 26 from receiving bale fill to receiving LLCS or LTPR does not alter the footprint of the cells or significantly alter the dimensions of the proposed final surfaces of the cells.

   The LLCS Cells are proposed to be constructed above the existing site surface, with clean surface water being diverted around the cells as is currently approved for the balefill cells formerly proposed for these locations.

   Stormwater drains will be developed sequentially as the LLCS cells are developed. Drains along inter-LLCS cell boundaries will be replaced with perimeter drains as each new cell is constructed. Drains and the stormwater detention pond will be constructed in accordance with relevant standards and guidelines.

   A proposed revision for the surface water management plan, including a concept drainage drawing, has been prepared and is attached in Appendix F. Detailed design will commence once approval of the concept design is granted. Detailed design of the stormwater drainage system will be included in detailed cell design to be submitted to the EPA for endorsement prior to cell construction.

Following approval of the proposed EIS amendment, the current LEMP will be revised to take into account the commitments made in the EIS amendment and associated documents, and submitted to EPA for approval prior to commencing the proposal. See also Appendix C which is the proposed additional chapter specific to the LLCS/LTPR cells.

7. Ausplume air dispersion modelling has been undertaken to predict the "worst case" ground level concentrations of odour (see Report in Appendix B). The outcomes of the modelling were compared against the EPA Guidelines. This assessment shows that the acceptance of LLCS and LTPR will not pose a risk to the nearest sensitive receptors in terms of odour generation from air dispersion.

   Air monitoring is a requirement of the current approved LEMP. Air monitoring around the LLCS Cells will be undertaken as part of this program, but will include specific monitoring for the LLCS Cells.

   During operations in a LLCS Cell, potentially hazardous volatile organic compounds will be monitored using a landfill gas monitor or similar. Should monitoring indicate exceedance of trigger values, work will cease in the Cell, and the vapour will be allowed to dissipate before work in the Cell recommences. Should operations be required to cease in the operating cell, monitoring will be undertaken at the down-wind landfill boundary to confirm the vapour concentration is less than the trigger value.

   Should a load of particularly odorous material be received at the LLCS Cell, it will be buried immediately under day cover to minimise the impact to site workers and the possibility of the odour impacting the nearest sensitive receptors.

   During periods when the LLCS cell is not operating, routine monitoring for odours and gases will be carried out as part of the site monitoring program. This may include gas monitoring using a landfill gas monitor or similar.

8. The result of HELP modelling is provided in Appendix E. The current proposed cap is a clay cap similar to that approved for the balefill cells (Scenario 2 from the modelling). This cap consists of a 0.6 metre thick clay capping layer overlain by 1.0 metre of restoration soils. Modelling indicates this scenario is likely to produce low volumes of leachate post closure.

Landfill Environmental Management Plan

(e) Comment: It is noted that the LEMP relates strictly to the existing balefill facility. While there are some common issues between the balefill and the proposal to receive LLCS and LTPR, a specific revised section of the LEMP is required to address the issues relevant to this proposal.

Response: Following approval, the LEMP will be revised to take into account commitments made in the EIS amendment and response document and required by the amended site approval. Draft chapters are provided in Appendices C (proposed additional chapter incorporating the management of the LLCS and LTPR cell) and G (proposed revision of the Surface Water Management Plan).

(f) Comment: Given the expected difference in leachate quality and potential reactivity and impacts on human health, it is considered that separate leachate systems should be established. The practice of recirculating leachate into the balefill cells may not be

appropriate for the LLCS and LTPR cells. Leachate from the LLCS/LTPR should not be recycled into the balefill cells as these may not be compatible with the waste material and could be toxic to bacteria in the putrescible waste and reduce the effectiveness of breakdown of the putrescible material.

Response: It is proposed to establish a hierarchical approach to leachate management from the LLCS Cells.

During the Spring, Summer and Autumn periods, when evaporation generally significantly exceeds precipitation, it is proposed the leachate be recirculated over an operating LLCS Cell. The bulk of what is expected to be a relatively low volume of liquid is expected to be lost to evaporation, with some seeping into the cell contents.

Should leachate need to be removed from the cells during winter, consideration will first be given to recirculating leachate over an operating LLCS Cell for evaporation and infiltration. If the LLCS is too wet to absorb the leachate, then leachate will be disposed to a Licensed Liquid Waste Treatment Plant.

If leachate recirculation is not accepted, leachate will be analysed and either disposed off-site to Licensed Liquid Waste Treatment Plant, or an evaporation basin may be constructed to dispose of leachate. Separate approval would be sought from EPA to install this basin, with the basin to be designed to a mutually agreed capacity. If onsite disposal to a leachate pond is undertaken, leachate will not be analysed prior to placement in the pond.

(g) Comment: Monitoring of leachate quality and groundwater quality for the new cells should be based on an analytical suite consistent with the expected chemicals in the LLCS/LTPR.

Response: Volatile Organic Compounds (VOCs), as a standard laboratory scan, are a proposed addition to leachate and nearby groundwater monitoring associated with the proposed low-level cells.

VOCs will be included in ongoing chemical analyses of leachate, which are currently required on a six-monthly basis.

For the relevant groundwater wells, VOC analysis of sampled groundwater is proposed to be included in addition to the current analytical suite as a minimum for the first year to establish background concentrations (if detectable). Following this period, wells will be sampled and analysed for trigger parameters, i.e.

- pH, EC, TDS by EC.
- Cations; Na, K.
- Nutrients; TKN (total Kjeldahl Nitrogen), Nitrate, Nitrite, Ammonia.
- TOC, BOD (total and biological oxygen demand).
- Selected Metals (Cd, Cr, Cu, Fe, Pb, Hg, Ni, Zn).

If the initial or ongoing analysis of LLCS/LTPR cell leachate shows that one or several VOCs are present in significant quantities, then those individual VOCs (or a full scan if no cost savings are available to analyse individual VOCs) would be added to the trigger parameter list for the affected wells.

Under the current groundwater regime, existing wells GW3 and GW4 are upgradient of the low-level cell location, and GW5 is downgradient. As the area being dewatered for conventional balefill cells shifts, groundwater flow beneath the planned low-level cells may

revert to the original southwesterly direction. An additional groundwater monitoring well (marked 'potential new monitoring bore' in Appendix I, Figure I-4) will be installed and sampled prior to construction of the LLCS/LTPR cells. Further details are given in Appendix C, Section XX.2.3.

(h) Comment: Construction of the lining system will be required to be supervised by a geotechnical engineering consultant with expertise in the preparation, implementation and reporting of QA/QC requirements and testing for both compacted clay liners and HDPE liners. Construction should be in accordance with Level 1 Supervision as defined in AS3798-1996. Prior to receipt of wastes, a certified report from a geotechnical consultant will be required to confirm that construction was in accordance with the design and QA/QC requirements.

Response: Supervision of construction will be undertaken in accordance with the relevant Australian Standards by a suitably qualified geotechnical engineer.

QA/QC requirements for the clay and HDPE liners are documented in Appendix G.

It is noted that the minimum spacing between the groundwater table and base of the secondary liner is 2.0 metres. The highest recorded groundwater table level from previous monitoring has been used to set the liner level shown on the conceptual design drawings in Appendix H.

(i) Comment: The sampling frequency and regime for leachate and groundwater quality will need to be consistent with the potential variability of contaminated soil received and hence variability in leachate.

Response: Leachate will be monitored 6 monthly in accordance with the current requirements of the LEMP, with the addition of VOCs. This list can be modified if deemed necessary based on the specific materials received. Leachate test results will be available for the received material, in accordance with the expected licence conditions.

If analysis of leachate shows significantly elevated concentrations of specific constituents not included in the triggers list of analysis for routine groundwater monitoring, these could be added to the trigger list (as contained in the existing LEMP and monitoring reports for the full and triggers lists) for the relevant monitoring wells.

(j) Comment: Monitoring and management measures for odours and volatile organic compounds will need to be included in the LEMP to ensure there are no unacceptable impacts at the site boundary and adjacent residences during waste receipt and until cell closure.

Response: Modelling indicate that odour will not pose a risk to the nearest sensitive receptors (Appendix B). Site monitoring has been discussed Monitoring and management measures will be included in the revised LEMP submission, (refer to draft additional chapter in Appendix C).

(k) Comment: Management measurements will need to be included in the LEMP that provide for the collection and appropriate disposal into the new cells of any contaminated soil/sediment from the truck wheel wash.

Response: A new wheel wash is proposed for the LLCS Cells. Wheel-wash sediment will be analysed prior to disposal or placed in low-level cells if volumes are small. Additional

information is included in the draft LLCS/LTPR chapter cell (Appendix C) proposed for inclusion in the revised LEMP.

In addition, the EPA seeks clarification and further information on the matters raised below:

(l) Comment: Page 2, Point 3 Surface Water. Additional information re the management of internal stormwater is requested. Current arrangements for stormwater management on the site are subject to ongoing improvements and cannot be relied upon as acceptable for the new proposal.

Response: The construction of the proposed LLCS Cell will be above the existing land surface (see Appendix H), ensuring a separation of the LLCS cells from site surface water. An amended stormwater management plan for the LEMP is provided in Appendix F, including a concept drainage design. Detailed design of the stormwater system will be design will be undertaken in accordance with relevant standards and guidelines, and submitted to EPA for approval as part of the detail design stage of this project.

(m) Comment: Pages 15, 16 Quantities to be received. Reference is made to potential quantities per annum of LLCS and LTPR. There appears to be no calculation provided in the Amended EIS as to the capacity of Cell 1 and potential future cells for materials of this nature. Details of calculations and supporting drawings to the appropriate scale are requested.

In addition, it is not clear how filling of Cell 31 would occur after reaching the top of the side batter. Detailed information, including drawings, clarifying the proposed methodology are requested.

With respect to Cell 31, additional information on surface water and leachate management is requested. This may incorporate both short and long term proposals and should include details of any final capping to achieve acceptable surface water and leachate management

Response: Based on the concept drawings for Cell 31 included in Appendix H, Cell 31 has an approximate cell capacity of 43,000m^3.

Filling of the Cell would proceed in a similar manner to that employed for the balefill cells. An access road will be constructed adjacent to the active cell, probably along a common LLCS cell boundary. The waste would be spread sequentially in layers, and wheel compacted.

A conceptual leachate drainage diagram is provided in Appendix H. This drawing shows the location of the leachate collection drains and the spine drain. Detailed drawings will be provided to the EPA for endorsement prior to construction on a cell by cell basis.

Proposed changes to the Surface and Leachate Water Management Plan are shown in Appendix F. This includes a concept surface water plan. Detailed design for collection and storage of surface water will be incorporated in the detail design phase of the project. The detail design will be submitted to EPA for approval. If accepted this modified plan will be included in the revised LEMP, and submitted to EPA for approval.

(n) Comment: Page 25 Buffer distance between cells: Point 8.2 refers to a buffer distance between the lining systems of balefill cells and LLCS and LTPR cells of at least 5 metres. It is not clear if this distance refers to the base-lining or side-lining systems or to the final capping. Clarification of this is requested.

Note that EPA requires a sufficient separation distance between the toes of the final caps of different types of cell to allow appropriate management at operational closure and post-closure stages.

Response: The 5 metre buffer refers to the distanced between the toe of the LLCS Cell structure and the cap of the nearest Balefill cells.

(o) Comment: Page 30 Post Closure Management: Under Point 10, reference is made to the current version of the Landfill Environment Management Plan (LEMP) which does not include management of LLCS and LTPR cells. Closure and post closure management should be addressed in a revised and updated LEMP.

Response: An additional chapter for the management of the LLCS/LTPR cell is shown as Appendix C. Following approval of this Amendment, the LEMP will be revised by inclusion of this chapter, and the inclusion of the revised Surface Water Management Plan (Appendix F).

(p) Comment: Leachate drainage material: Drawing 210225a-COI indicates a drainage gravel blanket of '100mm Max'. The EPA specification for leachate collection blankets applies and it is recommended that this figure is amended in the relevant drawing.

Response: The text referred to the thickness of the drainage layer under the pipe. The text"100mm Max" has been removed.

The thickness of the drainage blanket on Figure 1, Appendix H is 300mm. Current agreed gravel used in the drainage blanket for the balefill cells is proposed for this drainage blanket.

(q) Comment: Geocomposite drainage system: Drawing 210225a-COI indicates that the geo-composite drainage system (GDS) would not cover the full base of Cell 31. It is recommended that the GDS is extended over the full base of Cell 31 and into the side lining system to the upper level of the leachate drainage blanket.

Consideration should be given to the use of an anchor system to secure the GDS.

Response: The GDS will be extended over the full base of Cell 31, and into the side lining system to the upper level of the leachate drainage blanket (see Appendix H).

The method of securing the GDS will be in accordance with the manufacturer's specification.

(r) Comment: Cell side lining system as per Drawing 210225a-CO3. Drawing 210225a-CO3 indicates that the proposed side lining system will consist of a 600 mm compacted clay liner, overlayed by a 1.5mm HDPE geo-membrane and will be placed over a bund of selected fill.

Justification for the selection of this approach is requested including details of how it will maintain the integrity of the overall leachate management system.

Response: This design has been revised (Appendix H). Double lining of the cell walls will provide a barrier of negligible permeability. Leachate which reaches this barrier will migrate to the base of the cell where it will enter the leachate collection system.

(s) Comment: Drawing 210225a-CO1: Clarification of the following is requested:

- Scale
- Dimensions and capacity of Cell 31
- Design of leachate drainage system for Cell 31
- Location of monitoring well for leachate detection drain

Response: This drawing has been redrafted, and is now Figure 1, Appendix H.

(t) Comment: Drawing 210225a-CO2: Clarification of the following is requested:

- Scale
- Level measurements for groundwater, construction levels, ground levels, final height etc, shall be provided in metres AHD
- Section 2 refers to "measured groundwater table". It is recommended that the highest standing water level per the relevant monitoring record be adopted as the basis for determining construction levels.
- Cell filling height
- Cell capacity
- Buffer distances to adjoining cells.

Response: This drawing has been replaced. Refer to drawings in Appendix H.

(u) Comment: Drawing 210225a-CO3: Please provide all level measurements for groundwater, construction levels, ground levels, final height etc in metres AHD.

Response: This drawing has been replaced. Refer to drawings in Appendix H.

(v) Comment: Section 4.2.1: Included in Appendix F of the EIS amendment is a table of disposal criteria based on Table 2 of the waste soil condition (67-413) in the Southern Waste Depot EPA licence (13733). This table as presented is incomplete and has a number of errors including incorrect units and chemical criteria values.

Response: An amended table is included in Appendix A.

(w) Comment: Section 8.2: It is stated in this section that LLCS and LTPR will be stored in a separately constructed area. It is not clear how this will be implemented with regard to the proposed cells.

Response: The reference to a “separately constructed area” referred to the fact that these materials would not be placed within a balefill cell, but within purpose-built cells incorporating a significantly improved leachate management system. Cells 31, 30, 26 and 25 will be specifically constructed for storage of LLCS and LTPR. The use of these cells for this purpose is separate from the balefill operations. There is no intention to segregate LLCS and LTPR within these cells.

These cells will be separated from general waste cells by a lined bund wall, with a minimum separation distance of 5 metres between the base of the bund wall and the cap of the nearest balefill cells. Detailed drawings will be provided for endorsement prior to construction.

(x) Comment: Section 9.3: Details are requested of proposed air quality monitoring measures which are to be incorporated into the LEMP

Response: Proposed changes to air quality monitoring measures are discussed in Appendix C. Once approved, these monitoring measures will be included in the revised LEMP, and the revised LEMP submitted to EPA for approval.

4.2 Response to Comments - Department for Environment and Heritage

No comment.

Response: Noted.

4.3 Response to Comments - Department for Water Land and Biodiversity Conservation

No comment.

Response: Noted.

4.4 Zero Waste SA

No comment.

Response: Noted.

5. Response to Comments - Department for Human Services

(a) Comment: The Environmental Health Service is supportive of the development proposal in principle and we offer the following comments to assist in the EIS Amendment:

Response: Noted.

(b) Comment: Proximity to sensitive receptors: As the location of the proposed Cell 31 is in accordance with the recommendations outlined within the EPA Guidelines for Separation Distance (August 2000), it is considered to have an acceptable buffer zone between it and the neighbouring property. Following closure of Cells 25 or 26, any future cells which contain LLCS should be positioned west of Cells 25 and 26 so as to maintain a reasonable buffer zone to the border of the licensed property. Best practice procedures should be observed during the operation of the land fill site to minimise the potential of odour problems as outlined in item 3.

Response: Noted.

(c) Comment: Surface Water Resources: The facility must be operated so as to prevent the contamination of surface waters or ground water. Should the collection of stormwater include run off from cell areas, the possibility exists of contaminated water accumulating in the holding ponds. Should a 1- 25 year rain event cause the holding ponds to overflow this should not be allowed to discharge outside the facility. It is noted that the external surface water drain flows at times parallel to the internal surface water drain. At no time should the external surface water mix with the internal surface water as this may lead to the contamination of the external water flow. Any water holding ponds should be engineered to avoid leakage and prevent the possibility of creating a mosquito breeding habitat which has the potential to pose a nuisance or transmit arboviral diseases.

Response: Section 7 of the current LEMP details the surface water and drainage management procedures for the site. A revised surface water management plan for the development of these cells has been developed and is included in Appendix F. See also Appendix C.

(d) Comment: Dust and Odour generation: Uncontained dust and odour emissions may present a public nuisance. Providing the facility is operated within accepted norms (as described in the plan) and that buffer zones to the nearest sensitive receptors are 500 metres or more the likelihood of such nuisance is minimized. Operating conditions should be continually monitored to ensure that dust and odour are minimised to alleviate the potential nuisance or risk to health beyond the boundaries.

Response: Vapour and gas generation has been modelled (Appendix B) and the proposed monitoring and management measures are included in the proposed LLCS/LTPR cell chapter for the revised LEMP (Appendix C). This chapter will be added to the revised LEMP and submitted for approval.

(e) Comment: Noise generation: Should the nearest sensitive receptor be negatively impacted upon by noise there may be a potential for adverse health effects. It is recommended that at least the following noise levels be achieved to prevent the health effect(s) listed below (based on the WHO Guidelines for Community Noise). This may require incorporating noise control techniques during the design stage.

Specific environment max of dwellings (dB)	Critical health effects	LAeq (dB)	Time base (hrs)	LA Fast
Indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (façade or outdoor values)	45	8	60

Please note these levels may not protect sensitive groups, including shift workers, for sleep disturbance.

Response: An assessment of potential noise impacts from the landfill was undertaken in 2002 and found that operations were well within the EPA's criteria for noise. As a result, IWS were granted permission by the EPA to extend their operating hours. As this proposal will not change the nature of the operations, it is suggested that the same noise levels will apply and there will be no impact on surrounding properties. A complaints register is already in place to deal with air quality and noise issues external to the site.

6. Response to Comments - District Council of Mallala

(a) Comment: Council is concerned about the paucity of information for the assessment of the potential impacts of groundwater contamination. No details have been provided in relation to the contaminating substance within the soils and the chemical composition of the treatment plant residues and the reactive potential of combining such chemicals within the leachate. Hence it is difficult to determine the risks associated with the contamination of groundwater.

Response: Addressed in response to issues 2.1(a) and 2.1(d).

(b) Comment: The Proponent suggests that the aquifer immediately underlying the waste body is hyper saline and has no economic use. They also indicate the hyper saline aquifer is not connected to a second aquifer currently used for stock watering in the area. This is not a fact but needs to be tested as a hypothesis. Furthermore, even if the two aquifers are not connected this does not mean that the hyper saline aquifer is not connected to nearby salt lakes and coastal wetlands which provide habitat for migratory birds and plant species of national and international importance. Given clay liners generally leak, the above matters need to be rigorously tested prior to reaching the assumptions the Applicants appear to have so confidently reached in the EIS Amendment.

Response: This is addressed in the EIS. Information is well established including details about connection to the coast and travel time for groundwater.

(c) Comment: Council questions the assumptions underlying the conclusion reached in the EIS Amendment relating to an environmental audit of current operations including groundwater testing and the number of formal complaints as reliable indicators of past environmental performance. In the first instance Council questions whether the test results have been independently verified and if not, requests an independent audit be carried out by the EPA. Testing for contaminants in surface materials on nearby sabkas is also necessary to determine whether contamination has occurred via Brownian Motion. Furthermore, the register of complaints is a questionable indicator of environmental performance as many people may not be aware of the complaints procedures and may also be reluctant to lodge a formal complaint. A more reliable indicator would be to survey local residents by independent polling.

Response: Monitoring bores between landfill and sabkas will detect any groundwater contamination well before any impacts on sabkas could occur. An additional groundwater monitoring well is proposed southwest of the proposed low-level cells as discussed in response to issue 4.1(g).

The complaints register is a requirement of the site's licence and provides a formal means to record complaints, by whatever means they are communicated to the site operator. In addition, there is an ongoing Community Consultation Committee, which includes representatives of the operator, the local Council, government regulators and local residents. The availability of the complaints register can be promulgated by the committee members should any of them be approached regarding the operation of the site by people unaware of the complaints register. Monitoring results, as reported quarterly to the EPA, are available to the committee. In the past review by committee members has resulted in additional requested information being supplied to the parties, including improvements to the format and content of the environmental reports. This avenue will remain.

Polling of local residents is not proposed.

(d) Comment: The site is located in an important primary production area for open grazing, and intensive animal keeping catering for local and international markets. The deposit of as yet unknown contaminants gives Council cause for serious concern in relation to the potential for wind blown material affecting rural activities in the area. Coastal winds reach high velocities and carry soil particles for considerable distance. Although the EIS Amendment refers the reader to the LEMP it does not give a specific page reference and closer examination of the LEMP reveals that it does not address the specifics of the proposal as it was last amended in August 2001. In particular the potential for dust and wind erosion during the intervening period between dumping and providing a protective cover over dumped materials has not been addressed.

Response: Following approval, the LEMP will be revised to take into account commitments made in the EIS amendment and response document and required by the amended site approval. The proposed additional chapter to cover the operation of the LLCS/LTPR cell is shown in Appendix C and the proposed amendments to the surface water management plan are included in Appendix F.

(e) Comment: Much is made in the EIS Amendment of the point that the existing use of the site is for landfill and the proposal is also for landfill reaching the conclusion that the proposal would not alter the existing character and amenity of the area. Council is of the view that this is a trivial observation and misses the very significant fact that the proposal is altering the essential nature of the current land use. This is currently limited in terms of the receival of waste listed as prescribed except for asbestos bound in cement. As mentioned above the EIS Amendment does not satisfactorily answer serious questions relating to groundwater contamination, and the potential wind blown contamination of adjoining rural land.

Response: The existing use is approved for the site and this application only proposes one amendment which is of a similar nature to the existing use. Refer also to the response to issues 2.1(d) and 2.1 (f).

(f) Comment: A further point needs to be given due recognition, which is the perceived impact on the character of the rural area. It is one thing to have a landfill facility in an area zoned General Farming essentially for primary production but entirely another to have a facility which receives contaminated materials. Particularly where the scale of the proposal falls within the parameters of major social, economic and environmental significance. Council considers that the impact this would have on the perception of the area as suitable for primary production plus the economic impact on marketing of the area would be seriously detrimental.

These issues are central to determining the suitability of the proposal as an adjunct to the current use, within the context of a primary production area and the General Farming Zone. Consequently it cannot be said that the proposal is in accordance with Objective 1 for the General Farming Zone, which reads as follows:

Objective 1: Maintenance of general farming activities and land use on large property holdings.

The undesirable nature of the proposal is further underlined by the fact that it is listed as a non-complying form of Development in the General Farming Zone as follows:

Use of land for the reception, storage, treatment or disposal of waste, except for an organic waste processing facility...

Response: The existing use is approved for the site and this application only proposes one amendment which is of a similar nature to the existing use. Approval for the use of the entire site for modern landfill practice has been in force for some years. The low-level cells would be of equal height and eventually surrounded by conventional balefill cells, providing an additional buffer to surrounding landuse. The low-level cells have additional environmental protection provided by additional liners appropriate the nature of the low-level waste compared to conventional baled waste. The application is for one amendment to the existing approved use and is of a similar nature.

(g) Comment: Environmental Management: The objects of the Development Act 1993 provide a clear role for the Development Plan in relation to the management of land. Although the Amendment refers to the LEMP this has not been updated since August 2001 and does not relate to the specifics of the proposal at hand. As such it is essential that accurate management details pertinent to this assessment including onsite activities of the deposition of materials and leachate management have been provided.

Response: Preposed amendments to the LEMP are shown in Appendices C and G. Following approval, these sections will be incorporated in the existing LEMP, and the revised LEMP submitted to the EPA for endorsement.

(h) Comment: Council has serious concerns in relation to both the actual and perceived impacts of the proposed EIS Amendment. The paucity of relevant information in relation to the management and impacts of the proposal, plus the potentially flawed assumptions underlying the assessment of groundwater impacts and wind blown contaminants points to an absence of rigor in the EIS Amendment so much so that the Council questions the impartiality and objectivity involved in its preparation.

Response: Groundwater and potential impacts to groundwater were assessed thoroughly in the original EIS and are still applicable. HELP modelling has been undertaken to demonstrate minimal impacts to groundwater (Appendix E). Management of potential windblown contaminants is discussed in the proposed amendment to the LEMP (Appendix C). Once approved, this amendment will be included in the revised LEMP, and submitted to EPA for endorsement.

(i) Comment: Council is of the view that the proposal would be seriously detrimental to the character and amenity of the rural area and would be seriously at variance with the provisions for the General Farming Zone.

Response: The current use of the site as a landfill is approved, and this application proposes one amendment which is of a similar nature to the existing use. Refer to response to issue 6(f) above.

(j) Comment: Finally it is pointed out that the apparent arbitrary nature of the adopted consultation process leaves no opportunity for a public hearing for representors or for a personal representation in relation to Council's submission.

Response: The decision to process this application as an amendment to the original EIS was undertaken by Planning SA under delegation. The application is not for a substantially alteration in the use of the land which is an existing landfill. Council is represented on the site's Consultative Committee.

7. Response to Comments –Other Submissions

7.1 Action Against Underground Water Contamination Committee Inc. (J Webb)

(a) Comment: Express concern regarding the application to dispose of low level contaminated soil and liquid treatment plant residues.

Response: Noted

(b) Comment: Understand the waste will be placed in separate cells with double liner system incorporating a low permeability compacted clay liner, a high density polyethylene membrane liner and a leachate collection and management system. However, believe it is well-documented that all liners leak (Source: EPA) and it is accepted worldwide that all liners will leak in one form or other (USA EPA).

Response: While this opinion is accepted, the leakage is so minimal that it does not present a risk. Refer to HELP modelling in Appendix E.

The cell liners will be constructed in accordance with best practice for liners to meet the EPA and Planning SA's requirements.

7.2 Two Wells & Environs Strategic Planning Committee Inc, Organics Subcommittee (J Hurley)

(a) Comment: Object to the application for low level contaminated soil and liquid treatment plant residue facility.

Response: Noted.

(b) Comment: The application runs counter to the perceptions of the residents in establishing a "clean, green community" for the promotion of a healthy lifestyle and the establishment of an organic primary production sector.

Response: The application involves an amendment of the existing landfill use and as such is not expected to add to the impact of the landfill.

(c) Comment: The community group is trying to promote an image of environmentally friendly living with an emphasis on organic and chemical free primary production to meet a high market demand. Strongly object to proposal on the basis that it will impinge on the market's perception of the area.

Response: Adequate buffers have been provided and ongoing monitoring is undertaken for the current facility which will be extended to incorporate the proposed amendment.

7.3 D & DRA (C Lawrence and S Jones)

(a) Comment: The subject site falls within the District Council of Mallala General Farming Zone which principally means general farming activities.

Response: While the site is located within the General Farming Zone, the location of this site as a waste management facility has already been determined through an earlier approval, the amendment only seeks to change one condition.

(b) Comment: Site map appears to be inaccurate and not to scale. It appears disproportionate in relation to the coast property and adjoining landowners if the site is further away. If the site map is inaccurate, what is the case for all the other information?

Response: Site map is the same as was used in the approved EIS.

(c) Comment: The current Waste disposal point is visible from Highway 1.

Response: Not relevant to this proposal for an amendment.

(d) Comment: The subject site is bounded on the west by a Coastal Zone that includes samphire wetland, seasonal lagoon areas, feeding and resting habitat for migratory and resident shore birds. The nearby coastal area is considered to be part of the area listed under the Ramsar Convention and contains 20 Ramsar listed species. The Coastal Zone bounding the subject site is considered under Mallala Council's Samphire Coast Conservation Strategy. The Coastal Zone bounding the subject site contains species listed on the Federal Government's Endangered Plants and Animals list (EPBC).

The proposed waste (as described) has the real potential to destroy important coastal ecology by subterranean leaching due to the high degree of sand and gravel lenses contained within clay layers at the proposed site. These geological properties of the site would act as conduits for any escaping leachate to migrate off site in the event of liner failure.

Response: The application for amendment and the proposed changes to the LEMP detail the methods that will be used, such as liners, to ensure leaching from the landfill does not occur. Ongoing monitoring will be undertaken to identify if any impact is occurring external to the site at an early stage so that mitigation measures can be undertaken.

(e) Comment: It is an accepted view that all liners leak to varying degrees (Secure Hazardous Waste Study, draft final report, Sinclair Knight Merz, p.10)

A double liner system does not necessarily assure protection, but rather identifies the serious and dangerous nature of the substances to be stored.

Response: While this opinion is accepted, the leakage is so minimal that it does not present a risk. Also refer to the HELP modelling in Appendix E.

The cell liners will be constructed in accordance with best practice for liners to meet the EPA and Planning SA's requirements

(f) Comment: No specific breakdown of chemicals in contaminated soils or liquid waste residues or decay life cycle solely relies on contaminant dilutions of the subject site in terms of agricultural output.

Response: Noted.

(g) Comment: The EIS amendment July 2003 IWS is biased with respect to agricultural output and aims to undervalue the general area and its food production capabilities. The area has high importance in the Mallala economic zone.

The general area of the subject site is established and recognised for its high value intensive animal keeping and is central to the livestock industry within SA. e.g. Livestock Markets, LTD Nassier Live Import sheep feedlot, a number of cattle feedlots, chicken broiler farms, intensive piggeries, annual turnover > $200 Million.

Consumer and market expectations demand livestock production environments are clean, green and contaminant free.

Response: The existing use is approved for the site and this application proposes only one amendment which is of a similar nature to the existing use. It is not expected that there will be any additional impacts caused by the proposal to amend the EIS.

(h) Comment: The waste proposal provides no assurances or protection from wind blown contaminants or subterranean leaching into valuable potable stock water supply or adjoining lands.

Response: Groundwater protection measures are outlined in the amendment to the EIS and are further discussed in the responses to issues 2.1 (d) and 2.1(l). The current LEMP and proposed amendments (refer Appendices C and G) contain strategies for ongoing site management measures such as wind blown contaminants.

(i) Comment: *Development Authorization 3.1.1 states the power to grant or permit any variation associated with that development authorisation (provided that the essential nature of the development is not changed)* – The application is a complete change of land use and is at serious variance to the original development approval and now must require a separate EIS process including public consultation which must be acceptable to the community.

Response: The decision to process this application as an amendment to the original EIS was undertaken by Planning SA under delegation. The application is not for a substantially alteration in the use of the land which is an existing landfill.

(j) Comment: Large vehicles currently entering the site are causing a traffic impact to other road users and any increase in waste would exacerbate the current problem.

Response: The EIS amendment traffic assessment resolved that the increase in traffic movements of accepting the proposal would only be approximately 1.5% of the total traffic using Port Wakefield Road and is not considered to be significant.

No formal complaints have been received in relation to this issue.

(k) Comment: *P 18. states that the minimisation of land impacts will be ensured by placing the cells above the groundwater level and the use of an impervious barrier between the waste and the natural ground and groundwater, which allows the capture and management of any leachate from the waste* – this needs clarification, "groundwater level" does not indicate either seasonal or artificial level. Impervious barriers such as the clay liner when used for SISS system, are required to be pervious allowing for inward seepage to occur.

Response: The liner is designed to operate to suitable standard to meet the requirements of the EPA and Planning SA (see responses above for further detail) and is different to the SISS system for these cells. Refer to Appendix H for the revised conceptual design drawings.

Ongoing groundwater monitoring will identify any issues and enable mitigation measures to be implemented should problems occur.

(l) Comment: The proposal is in serious breach of Mallala's development plan general farming zone objective B 1 and 2 part b, c and d.

Response: The existing use is approved for the site and this application proposes only one amendment which is of a similar nature to the existing use. Refer also to the response to issue 7.3 (g).

(m) Comment: *7.2 Deep Groundwater Aquifer*

…quality is poor and is normally limited to stock watering purposes... – this is an attempt to undervalue the complete reliance that livestock producers have on this important resource that must be secure from any level of contaminants.

Response: Analysis of current groundwater conditions has demonstrated the existing poor but stable quality.

(o) Comment: *8.3 Groundwater Protection*

The probability of water well drawdown should not be underestimated, and future demands should not be understated particularly in times of drought.

Response: Groundwater specialists consider it highly unlikely that there will be any impact on the deep groundwater resource as a result of the small water use by the proposal.

(p) Comment: It is unacceptable that no extra groundwater monitoring should occur and that the applicant expects "a leveraging" off of the extensive controls. The addition of contaminated waste and liquid residue waste by definition must require more extensive additional monitoring.

Response: Additional monitoring will be undertaken where appropriate, as discussed in the response to issue 4.1 (g).

(q) Comment: How many years is the high density polyethylene geomembrane lining system guaranteed for?

Response: The effective life of the membrane can only be estimated based on extrapolation of experience of the use of HDPE in various conditions. A paper presented to the 1998 6th international conference on Geosynthetics predicts that the effective service life of geosynthetic HDPE membrane will be considerably greater than 100 years, with a likely life span performance of 400 years.

(r) Comment: The community will require an independent review of the composite lining system material, being inert by definition does not assure a safeguard.

Response: The EPA as the appropriate authority will analyse the suitability of the liner for the approval process.

(s) Comment: Why did LCCC Forum take so long to be established, particularly when it was a requirement of development authorisation and community interest was registered with the EPA etc. in Feb 1998.

Response: Not relevant to this proposal for an amendment.

(t) Comment: All community concerns should be duly registered regardless of formality.

Response: Not relevant to this proposal for an amendment.

(u) Comment: The siting of a major waste dump in the general farming zone within the confines of a major food production area is inappropriate, wrong and completely incompatible with quality assurance programs in place on the adjoining livestock facilities!

Response: The existing use is approved for the site and this application only proposes one amendment which is of a similar nature to the existing use. Refer also to the response to issue 7.3(g).

(v) Comment: The Minister for Urban Housing Development said at a meeting (30/1/98) that “it won’t be allowed” (receipt of wastes).

Response: Not relevant to this proposal for an amendment.

(w) Comment: In the absence of any long term key performance indicators information relating to proven safeguards environmentally or otherwise should be viewed in its real context and with caution.

Response: The EPA as the appropriate authority will analyse the environmental suitability of the proposal for the approval process.

(x) Comment: What is the need for such a facility?

Response: As outlined in the EIS Amendment.

(y) Comment: What currently happens to all this harmful waste?

Response: It is believed that waste of a similar type can be disposed of to the Southern Waste Depot, Maslin Beach.

(z) Comment: We believe there is current technology that could alleviate the need for such a facility, why is that explored further?

Response: There is no economically viable technology for the destruction of most of the proposed waste. Without an appropriate disposal facility this type of waste could remain stored in less suitable areas, resulting in potential risks to human health and the environment.

(a1) Comment: The EIS Amendment enhances the myth that major landfills can be beneficial environmentally, economically and harmonious in a social context.

Response: Not relevant to this proposal for an amendment.

(b1) Comment: Historically major landfills have been problematic and only benefit one sector.

Response: Not relevant to this proposal for an amendment.

Appendix A

Classification of Waste

Criteria for the Receipt of Contaminated Soil

Substance	Contaminated Soil					TPR
	Waste Fill	Intermediate Low Level Contaminated Fill		Low Level Soil		
	Dry Weight (mg/kg)	Dry Weight (mg/kg)	Max Leach (mg/L)	Dry Weight (mg/kg)	Max Leach (mg/L)	Max Leach (mg/L)
aldrin/dieldrin	<2	<2	#	<50	0.1	0.1*
arsenic	<20	<200	5	<750	5	5
B(a)P	<1	<2	#	<5	0.001	0.001*
barium	<300					100
beryllium	<20	<40	1	<150	1	1*
cadmium	<3	<30	0.5	<60	0.5	0.5
cobalt	<170	<170	#	<1,000	#	#*
chlordane	<2	<2	#	<50	0.6	0.6*
chromium (total)						20
Cr3	<400	<12%	#	<30%	#	#*
Cr6	<50	<200	5	<750	5	5
copper	<60	<2,000	10	<7,500	10	10
cyanides (total)	<500	<1,000	10	<3,500	10	10*
DDT	<2	<2	#	<50	0.3	0.3*
heptachlor	<2	<2	#	<50	0.3	0.3*
iron						100
lead	<300	<1,200	5	<5,000	5	5
manganese	<500	<6,000	50	<10,000	50	50
methyl mercury		<20	#	75	#	#*
mercury	<1	<30	0.1	<110	0.1	0.1
nickel	<60	<600	2	<3,000	2	2
PAH (total)	<5	<40	#	<200	#	#*
PCB	<2	<2	#	<50	#	#*
phenolic compounds (total)	<0.5	<17,000	#	<50,000	14.4	14.4*
silver						5
zinc	<200	<14,000	250	<50,000	250	250
TPH $C_6 - C_9$	<65	<100	#	<1,000	#	#*
TPH $>C_9$	<1,000	<1,000	#	<10,000	#	#*
benzene	<1	<5	#	<15	1	1*
ethylbenzene	<3.1	<100	#	<1,000	30	30*
toluene	<1.4	<50	#	<500	14.4	14.4*
Xylene (total)	<14	<180	#	<1,800	50	50*

* = LTPR criteria taken from low level soil criteria

= not applicable if max dry weight level is not exceeded.
< = less than
Results must be from a NATA certified laboratory.

Physical characteristics for clean fill and intermediate landfill cover area as follows:

- Clean fill – less than 100 mm in diameter, homogenous, consisting of clay, soil or crushed rock. Not containing significant organic material such as timber, vegetable matter or other waste materials including asbestos and bitumen.
- Intermediate landfill cover – less than 200 mm in diameter. Not containing significant organic material such as timber, vegetable matter or other waste materials.

Appendix B

Air Dispersion Modelling

Air Dispersion Modelling IWS Northern Balefill Landfill

6 November 2003

Integrated Waste Services P/L

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Signed:

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Appendices

1. Introduction

Parsons Brinckerhoff (PB) was commissioned by Integrated Waste Services P/L (IWS) to undertake air dispersion modelling for potentially odourous emissions from the Northern Balefill Resource Recovery and Transfer Facility near Dublin, 50km north of Adelaide. The modelling was requested in order to determine the potential environmental impact of a proposed alteration in operation at the landfill, in which low level contaminated soil (LLCS) and liquid treatment plant residues (LTPR) are to be accepted into a designated cell at the site.

PB used the Ausplume Gaussian Plume Dispersion Model Version 5.4, published by the Victorian EPA, to predict the "worst case" ground level concentrations (GLC's) of odour. These GLCs were compared to the odour criteria contained in the South Australian EPA document titled "EPA guidelines – Odour assessment using odour source modelling".

Model inputs have been based on conservative assumptions from previous work undertaken by PB and knowledge of the operations currently at the site.

2. Landfill Operation

The site's operations are managed in accordance with an EPA approved Landfill Environmental Management Plan which is frequently revised and updated. Regular revision ensures that best practice operating procedures and continuous improvement are maintained by the landfill operator. The proposed additions will result in an estimated 20,000 tonnes per annum of LLCS and 10,000 tonnes per annum of LTPR being accepted on the site. It has been previously assumed that the maximum extra truckloads that might be expected to enter the site would be 8 per day.

In order to maintain an acceptable buffer distance between the LLCS and LTPR cell, and the industrial and municipal landfill cells, any future cells are to be constructed with a buffer distance of at least 5 metres.

The following assumptions have been made in relation to the operations at the landfill.

- The operational face of the disposal area is unlikely to be greater than 10m by 10m ($100m^2$) at any one time. For conservatism, an operational face of 15m by 15m ($225m^2$) has been modelled;
- The material accepted on site would be covered by clean fill material before the end of each work day, leaving none exposed to the atmosphere; and
- The cell that is intended to accept the new material streams is Cell 31, which is located at the northern end of the Stage 4 block of cells. The cell is about 500m from the eastern boundary of the site, the approximate direction of the cell's nearest sensitive receptor.

3. Model Assumptions

The following input assumptions have been made in modelling the odour concentrations.

- An odour flux of 370 ouv/m^2/min was used. This odour flux is comparable to bituminous type products which are likely to be far more odourous than low level contaminated soil, and is considered conservative.;
- Emissions from the landfill will be assumed to continue for 24 hours a day. This is considered conservative as the disposal face will be covered at the end of every day;
- The meteorological file used for the model was the Edinburgh data. This was deemed as the most appropriate location to reflect the weather conditions that would be expected at the Northern Balefill facility;
- Management of existing potential odour sources are the subject of an extensive management plan at the facility, and there has been no history of odour problems from the site's activities. As a result the background odour level at the site was assumed to be negligible;
- Building wake effects have been ignored due to the absence of substantial buildings at the facility;
- A flat rural terrain was assumed, with a land use representative of flat rural. This corresponds to a surface roughness height of 0.1m and is considered conservative;
- A 2000m receptor grid with Cartesian coordinates was selected with receptor spacings of 50m; and
- In addition the nearest sensitive receptors (two houses) were input into the model at the following receptor locations (House A at (980,360)) and (House B at (760, -816)). Also, two further discrete receptors have been included at the property boundary in a direct line with the two houses (Boundary A at (615, 226) and Boundary B at (636, -695)). The point (0,0) is the central point of Cell 31.

4. Results and Discussion

4.1 Regulatory Requirements

"Guidelines for odour assessment using odour source modelling" produced by the South Australian EPA specifies odour criteria, dependent on population density in the site vicinity. The levels are applied to the closest residence to the site contained in the populated area. The limits for odour levels, based on a three minute averaging period are contained in Table 4.1.

Table 4.1: Odour Criteria

Population Density	Odour Unit Criteria (3-min average, 99.9%)
2000 or more	2
350 or more	4
60 or more	6
12 or more	8
Single residence	10

Cell 31 of the Northern Balefill site is located approximately 500m from the site boundary and over a kilometre from the nearest residences. The closest sensitive receptors are two houses; one is located to the NEE of the cell (House A – approximately 1km from Cell 31) and one to the SE of the cell (House B – approximately 1.1km from Cell 31). Subsequently an odour limit target of 10 odour units at these sensitive receptors is appropriate for this model.

4.2 Modelling Results

Table 4.2 below summarises the results obtained by the model and makes a comparison with the relevant standard.

Table 4.2: Results and Comparison to Legislative Requirements

Scenario	Species	Sensitive Receptor	Calculated Odour Level	Odour Unit Criteria
15m x 15m ($225m^2$)	Odour	House A	1.16 ou	10 ou
		House B	0.507 ou	
		Boundary A	2.41 ou	
		Boundary B	0.837 ou	

As outlined in Sections 2 and 3, the model contains a number of conservative assumptions to ensure that the predicted ground level concentration is not under-estimated. The highest 100 results of the modelling and the highest and second highest results at the discrete receptors are contained in Appendix A. As is to be expected, the highest recorded concentrations are in the immediate vicinity of Cell 31. A concentration plot of the emissions is included in Appendix B.

4.3 Conclusion

The modelling undertaken indicates that the acceptance of LLCS and LTPR will not pose a risk to the nearest sensitive receptors in terms of odour generation. Under the maximum foreseeable operating surface area, the maximum odour predicted to reach the nearest sensitive receptor (House A) was just over 1 odour unit compared with an odour criteria specified by the South Australian EPA of 10 odour units. The ground level concentrations at the boundary taken in a direct line between Cell 31 and the nearest houses, were also well under the 10 odour unit criteria.

Appendix A

Ausplume Model Input Parameters and Results

Dublin-Odour

_____

Concentration or deposition Concentration
Emission rate units OUV/second
Concentration units Odour_Units
Units conversion factor 1.00E+00
Constant background concentration 0.00E+00
Terrain effects None
Smooth stability class changes? No
Other stability class adjustments ("urban modes") None
Ignore building wake effects? Yes
Decay coefficient (unless overridden by met. file) 0.000
Anemometer height 10 m
Roughness height at the wind vane site 0.300 m

DISPERSION CURVES
Horizontal dispersion curves for sources <100m high Pasquill-Gifford
Vertical dispersion curves for sources <100m high Pasquill-Gifford
Horizontal dispersion curves for sources >100m high Briggs Rural
Vertical dispersion curves for sources >100m high Briggs Rural
Enhance horizontal plume spreads for buoyancy? Yes
Enhance vertical plume spreads for buoyancy? Yes
Adjust horizontal P-G formulae for roughness height? Yes
Adjust vertical P-G formulae for roughness height? Yes
Roughness height 0.100m
Adjustment for wind directional shear None

PLUME RISE OPTIONS
Gradual plume rise? Yes
Stack-tip downwash included? Yes
Building downwash algorithm: PRIME method.
Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
Partial penetration of elevated inversions? No
Disregard temp. gradients in the hourly met. file? No

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Rural" values (unless overridden by met. file)

AVERAGING TIME: 3 minutes.

1

Dublin-Odour

SOURCE CHARACTERISTICS

AREA SOURCE: CELL31

X(m)	Y(m)	Ground Elevation	Height	Side length
0	0	0m	0m	15m

(Constant) emission rate = 6.17E+00 OUV/second per square metre
No gravitational settling or scavenging.

1

Dublin-Odour

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
-2000.m -1950.m -1900.m -1850.m -1800.m -1750.m -1700.m
-1650.m -1600.m -1550.m -1500.m -1450.m -1400.m -1350.m
-1300.m -1250.m -1200.m -1150.m -1100.m -1050.m -1000.m
-950.m -900.m -850.m -800.m -750.m -700.m -650.m
-600.m -550.m -500.m -450.m -400.m -350.m -300.m
-250.m -200.m -150.m -100.m -50.m 0.m 50.m
100.m 150.m 200.m 250.m 300.m 350.m 400.m
450.m 500.m 550.m 600.m 650.m 700.m 750.m
800.m 850.m 900.m 950.m 1000.m 1050.m 1100.m
1150.m 1200.m 1250.m 1300.m 1350.m 1400.m 1450.m
1500.m 1550.m 1600.m 1650.m 1700.m 1750.m 1800.m
1850.m 1900.m 1950.m 2000.m

and these y-values (or northings):
-2000.m -1950.m -1900.m -1850.m -1800.m -1750.m -1700.m
-1650.m -1600.m -1550.m -1500.m -1450.m -1400.m -1350.m
-1300.m -1250.m -1200.m -1150.m -1100.m -1050.m -1000.m
-950.m -900.m -850.m -800.m -750.m -700.m -650.m
-600.m -550.m -500.m -450.m -400.m -350.m -300.m
-250.m -200.m -150.m -100.m -50.m 0.m 50.m
100.m 150.m 200.m 250.m 300.m 350.m 400.m
450.m 500.m 550.m 600.m 650.m 700.m 750.m
800.m 850.m 900.m 950.m 1000.m 1050.m 1100.m
1150.m 1200.m 1250.m 1300.m 1350.m 1400.m 1450.m
1500.m 1550.m 1600.m 1650.m 1700.m 1750.m 1800.m
1850.m 1900.m 1950.m 2000.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	980	360	0.0	0.0	3	615	226	0.0	0.0
2	760	-816	0.0	0.0	4	636	-695	0.0	0.0

METEOROLOGICAL DATA : BoM Edinburgh Data & Adelaide Upperair :Surface Roug
h

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in Odour_Units)
AVERAGING TIME = 3 MINUTES

At the discrete receptors:

1: 1.16E+00 @Hr23,02/07/97 3: 2.41E+00 @Hr23,02/07/97
2: 5.07E-01 @Hr23,15/07/97 4: 8.37E-01 @Hr23,15/07/97

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1 SECOND-HIGHEST RECORDINGS FOR EACH RECEPTOR (in Odour_Units)
AVERAGING TIME = 3 MINUTES

At the discrete receptors:

1: 5.82E-01 @Hr23,20/12/97 3: 1.21E+00 @Hr23,20/12/97
2: 5.07E-01 @Hr03,07/10/97 4: 8.37E-01 @Hr03,07/10/97

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1 Peak values for the 100 worst cases (in Odour_Units)
Averaging time = 3 minutes

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)
1	7.03E+01	04,21/03/97	(0, -50, 0.0)
2	7.03E+01	01,31/03/97	(0, -50, 0.0)
3	7.03E+01	19,13/04/97	(0, 50, 0.0)
4	7.03E+01	02,24/05/97	(50, 0, 0.0)
5	7.03E+01	05,02/07/97	(0, -50, 0.0)
6	7.03E+01	04,16/09/97	(0, -50, 0.0)
7	7.03E+01	05,16/09/97	(0, -50, 0.0)
8	7.03E+01	24,21/09/97	(-50, 0, 0.0)
9	7.03E+01	05,24/11/97	(0, -50, 0.0)
10	4.17E+01	23,27/02/97	(-50, 50, 0.0)

11	4.17E+01	18,23/05/97	(	-50,	50,	0.0)
12	4.17E+01	04,17/06/97	(	-50,	50,	0.0)
13	4.17E+01	16,01/07/97	(	50,	-50,	0.0)
14	4.17E+01	20,29/07/97	(	-50,	50,	0.0)
15	4.17E+01	02,23/01/97	(	50,	50,	0.0)
16	4.17E+01	21,07/02/97	(	50,	50,	0.0)
17	4.17E+01	07,22/04/97	(	50,	50,	0.0)
18	4.17E+01	19,09/06/97	(	50,	50,	0.0)
19	4.17E+01	24,01/07/97	(	50,	50,	0.0)
20	4.17E+01	01,02/07/97	(	50,	50,	0.0)
21	4.17E+01	20,21/08/97	(	50,	50,	0.0)
22	4.17E+01	21,21/08/97	(	50,	50,	0.0)
23	4.17E+01	01,16/09/97	(	50,	50,	0.0)
24	4.17E+01	23,11/03/97	(	-50,	-50,	0.0)
25	4.17E+01	23,16/05/97	(	-50,	-50,	0.0)
26	4.17E+01	07,15/06/97	(	-50,	-50,	0.0)
27	4.17E+01	24,18/06/97	(	-50,	-50,	0.0)
28	4.17E+01	01,19/06/97	(	-50,	-50,	0.0)
29	4.17E+01	01,25/01/97	(	-50,	50,	0.0)
30	4.17E+01	06,10/02/97	(	-50,	50,	0.0)
31	4.17E+01	23,08/05/97	(	-50,	50,	0.0)
32	4.17E+01	22,10/05/97	(	-50,	50,	0.0)
33	4.17E+01	06,12/05/97	(	-50,	50,	0.0)
34	4.17E+01	22,03/07/97	(	-50,	50,	0.0)
35	4.17E+01	23,15/07/97	(	50,	-50,	0.0)
36	4.17E+01	24,28/07/97	(	50,	-50,	0.0)
37	4.17E+01	22,15/09/97	(	-50,	50,	0.0)
38	4.17E+01	23,15/09/97	(	-50,	50,	0.0)
39	4.17E+01	03,07/10/97	(	50,	-50,	0.0)
40	4.17E+01	01,17/10/97	(	-50,	50,	0.0)
41	4.17E+01	02,17/10/97	(	-50,	50,	0.0)
42	3.51E+01	22,31/01/97	(	0,	50,	0.0)
43	3.51E+01	01,01/02/97	(	50,	0,	0.0)
44	3.51E+01	01,03/02/97	(	-50,	0,	0.0)
45	3.51E+01	24,20/02/97	(	0,	50,	0.0)
46	3.51E+01	24,21/03/97	(	0,	50,	0.0)
47	3.51E+01	01,22/03/97	(	0,	50,	0.0)
48	3.51E+01	24,14/04/97	(	0,	50,	0.0)
49	3.51E+01	01,15/04/97	(	0,	50,	0.0)
50	3.51E+01	02,15/04/97	(	0,	50,	0.0)
51	3.51E+01	03,15/04/97	(	0,	50,	0.0)
52	3.51E+01	22,17/05/97	(	0,	50,	0.0)
53	3.51E+01	07,05/07/97	(	0,	-50,	0.0)
54	3.51E+01	23,19/07/97	(	0,	50,	0.0)
55	3.51E+01	24,19/07/97	(	0,	50,	0.0)
56	3.51E+01	01,20/07/97	(	0,	50,	0.0)
57	3.51E+01	02,24/07/97	(	-50,	0,	0.0)
58	3.51E+01	04,31/07/97	(	50,	0,	0.0)
59	3.51E+01	05,04/08/97	(	-50,	0,	0.0)
60	3.51E+01	24,19/08/97	(	-50,	0,	0.0)
61	3.51E+01	22,01/09/97	(	0,	-50,	0.0)
62	3.51E+01	18,16/09/97	(	0,	-50,	0.0)
63	3.51E+01	22,21/10/97	(	0,	50,	0.0)
64	3.51E+01	04,30/10/97	(	0,	50,	0.0)
65	3.51E+01	20,05/12/97	(	0,	50,	0.0)
66	3.51E+01	22,19/12/97	(	0,	50,	0.0)
67	3.51E+01	23,19/12/97	(	0,	50,	0.0)
68	3.28E+01	03,30/03/97	(	0,	50,	0.0)

69	3.28E+01	04,30/03/97	(0,	50,	0.0)
70	3.28E+01	05,30/03/97	(0,	50,	0.0)
71	3.28E+01	22,28/07/97	(0,	50,	0.0)
72	3.28E+01	03,29/07/97	(50,	0,	0.0)
73	3.28E+01	04,29/07/97	(50,	0,	0.0)
74	3.28E+01	05,29/07/97	(50,	0,	0.0)
75	3.28E+01	06,29/07/97	(50,	0,	0.0)
76	3.28E+01	01,20/10/97	(0,	50,	0.0)
77	3.28E+01	02,20/10/97	(0,	50,	0.0)
78	3.28E+01	04,17/12/97	(50,	0,	0.0)
79	3.28E+01	05,17/12/97	(50,	0,	0.0)
80	3.28E+01	06,13/02/97	(-50,	0,	0.0)
81	3.28E+01	01,16/03/97	(-50,	0,	0.0)
82	3.28E+01	02,16/03/97	(-50,	0,	0.0)
83	3.28E+01	23,01/04/97	(0,	-50,	0.0)
84	3.28E+01	01,03/07/97	(-50,	0,	0.0)
85	3.28E+01	02,03/07/97	(-50,	0,	0.0)
86	3.28E+01	02,02/08/97	(0,	-50,	0.0)
87	3.28E+01	07,04/08/97	(-50,	0,	0.0)
88	3.28E+01	23,20/09/97	(0,	-50,	0.0)
89	3.28E+01	06,21/09/97	(-50,	0,	0.0)
90	3.28E+01	06,22/09/97	(-50,	0,	0.0)
91	3.28E+01	04,23/10/97	(0,	-50,	0.0)
92	3.28E+01	02,16/02/97	(0,	-50,	0.0)
93	3.28E+01	03,16/02/97	(0,	-50,	0.0)
94	3.28E+01	01,22/04/97	(-50,	0,	0.0)
95	3.28E+01	01,16/06/97	(-50,	0,	0.0)
96	3.28E+01	03,16/09/97	(-50,	0,	0.0)
97	3.28E+01	02,18/10/97	(-50,	0,	0.0)
98	3.28E+01	18,28/05/97	(50,	0,	0.0)
99	3.28E+01	01,15/10/97	(0,	50,	0.0)
100	3.28E+01	24,11/11/97	(0,	50,	0.0)

Appendix B

Concentration Contour Plots

Appendix C

Additional LEMP Chapter for LLCS/ LTPR Cells

Section XX

XX Management of Low Level Contaminated Soil (LLCS) and Liquid Treatment Plant Residue (LTPR) – Draft

Management of the LLOC and LTPR Cells (low level cells) is proposed to be undertaken as part of the ongoing environmental management of the IWS Northern Balefill, and as such will operate within a revised IWS Northern Balefill LEMP. The current LEMP (revised August 2001) does not include provision for the low level cells, and will require amendment following approval of this proposed development. This Section is proposed for inclusion in the revised LEMP, and relates specifically to matters relevant to the proposed low level cells.

The location of the proposed cells to receive low-level contaminated soil and liquid treatment plant residues are Cells 25, 26, 30 and 31. In accordance with the EIS Amendment, it is proposed to construct Cell 31 as the initial low level contaminated soil and liquid treatment plant residue cell.

XX.1 Cell Design and Construction

The design and construction of the lining and leachate collection system will be in accordance with Section 8.4 of the EIS Amendment Receipt of Low Level Contaminated Soil and Liquid Treatment Plant Residues at the IWS Northern Balefill (EIS Amendment; dated July 2003), as amended by the Revised Response Document dated 30 April 2004..

The detailed design of the lining and leachate collection system and supervision of construction will be undertaken by a suitably experienced geotechnical engineering consultant. Design will be in accordance with the design parameters used in the HELP modeling undertaken as part of the Revised Response Document on the EIS Amendment for the Receipt of Low Level Contaminated Soil and Liquid Treatment Plant Residues, Revision B (RRD; PB reference 03-0785-03 dated 30 April 2004).

Supervision of construction of the Low Level Contaminated Soil and Liquid Treatment Plant Residue cells will be in accordance with Level 1 Supervision as outlined in Australian Standard AS 3798-1996 “Guidelines on Earthworks for Commercial and Residential Developments”. The supervising consultant will require expertise in compaction control and testing, and QA/QC requirements for HDPE liners.

An engineer’s report will be provided at the completion of liner and cap construction to certify that the works have been undertaken in accordance with the design.

XX.2 Groundwater and Leachate Management

XX.2.1 Background

Section 8.3 of the EIS Amendment identifies the need for groundwater protection. Section 5 of the IWS LEMP (revised August 2001) contains the current Groundwater and Leachate Management Plan. Groundwater and leachate management of the low level cells will be in general accordance with the current LEMP, with the following amendments.

XX.2.2 Low Level Cell Leachate Management

Site experience and HELP modeling conducted as part of the RRD indicates that the rate of leachate generation should be low.

It is proposed to establish a hierarchical approach to leachate management from the LLCS Cells.

During the spring, summer and autumn periods, when evaporation generally exceeds precipitation, it is proposed the leachate be recirculated over an operating LLCS Cell. The bulk of what is expected to be a relatively low level of liquid is expected to be lost to evaporation, with some seeping into the cell contents.

Should leachate need to be removed from the cells during winter, consideration will first be given to recirculating leachate over an operating LLCS Cell for evaporation and infiltration. If the LLCS is too wet to absorb the leachate, then leachate will be disposed to a Licensed Liquid Waste Treatment Plant.

If leachate recirculation is not accepted, leachate will be analysed and either disposed off-site to Licensed Liquid Waste Treatment Plant, or an evaporation basin may be constructed to dispose of leachate. Separate approval would be sought from EPA to install this basin, with the basin to be designed to a mutually agreed capacity. If onsite disposal to a leachate pond is undertaken, leachate will not be analysed prior to placement in the pond.

VOCs will be added to the current (standard) analytical suite for leachate analysis, and sampled as part of the six monthly sampling round. The presence of significant VOCs within leachate will act as a trigger for the addition of VOCs to the current (standard) groundwater analytical suite (see section XX.2.3 below).

XX.2.3 Groundwater Monitoring

The overall groundwater flow direction is towards the southwest, with some modification by the influence of dewatering drains beneath Cells 1 and 2.

Under the current groundwater regime, existing wells GW3 and GW4 are upgradient of the low-level cell location, and GW5 is downgradient. As the area being dewatered for conventional balefill cells shifts, groundwater flow beneath the planned low-level cells may revert to the original southwesterly direction. In this instance, an additional groundwater monitoring well will be installed west of Cell 30 prior to the construction of the first low-level cells. This well will be first sampled prior to the operation of that cell.

Well GW4 is sampled as part of the current groundwater monitoring program at the site, whilst GW3 and GW5 are monitored for groundwater level only. GW3, 4, 5 and the new well will be sampled for trigger parameters and VOCs for the first year of operation of the low-level cells, with individual VOC analytes or a VOC scan added for ongoing monitoring if significant VOCs are detected in low-level cell leachate samples.

XX.2.3.1 Proposed Groundwater Analytical Suite

Groundwater analysis in the vicinity of the low level cells will be undertaken in two stages:

- During the first year of groundwater monitoring samples will be collected six monthly to establish background levels of analytes in this area. Samples will be analysed for the full current (Balefill) analytical suite + VOCs.

- In Year 2 and subsequent years sampling will be six monthly. Samples will be analysed for the current (Balefill) trigger analytes plus VOCs if significant VOCs are indicated by leachate analysis.

If the initial or ongoing analysis of low-level cell leachate shows that any analyte (including VOCs) is present in significant quantities, then those individual analytes would be added to the trigger parameter list for the associated groundwater monitoring wells.

XX.3 Air Quality and Noise Management

XX.3.1 Air Quality

Air dispersion modeling was undertaken as part of the RRD using "worst case" ground level concentrations of odour, and the outcomes assessed against EPA Guidelines. The results of this assessment indicate that the low level cells are unlikely to pose a threat to the nearest sensitive receptors in terms of odour generation and air dispersion.

As a precaution, and in accordance with Section 9 of the current LEMP (Air Quality and Noise Management Plan), the following will apply to the low level cells:

- all incoming loads are required to be covered;
- placement of daily cover will occur as part of daily site maintenance in accordance with Section 9.5 of the current LEMP; and
- odour assessment/monitoring of the low level cells will be conducted in accordance with Section 9.5 of the LEMP as an extension of the current odour assessment at the site.

Additionally, the following will apply to the receipt of LLCS and LTPR:

- no LLCS will be received by the low level cell unless it meets the Low Level Soil guidelines as shown in Appendix G to the RRD. It will be required to be accompanied by all relevant documentation, including Waste Tracking Forms and documentation confirming its compliance with the Low Level Soil guidelines as shown in Appendix G to the RRD;
- LTPR will only be received from licenced treatment plants (Cleanaway (George St Wingfield) and Collex (Churchill Rd Kilburn)), and transported in licenced vehicles, in accordance with EPA waste transport codes and requirements; and
- no LTPR will be received at the site unless accompanied by all relevant documentation, including Waste Tracking Forms and documentation confirming its compliance with nominated EPA leachability and landfill criteria.

XX.3.1.1 Monitoring During LLCS Cell Operation

During operations in the LLCS Cell, potentially hazardous volatile organic compounds will be monitored using a landfill gas monitor, or similar. Should monitoring indicate values exceeding trigger values, work will cease in the Cell in operation, and the vapor or gas will be allowed to dissipate before work recommences in the Cell. Monitoring will be undertaken at the down-wind landfill boundary to confirm the vapor concentration leaving the site is less than trigger values.

If the concentration leaving the site boundary exceeds trigger values immediate steps will be taken to reduce the gas or vapor concentration. This may include use of odour suppressants such as "Biosolve", the immediate burial under day cover of recently received LLCS or LTPR if it is safe to access the cell, or such other steps as are necessary to reduce the vapor concentration at the site boundary below trigger levels.

Should a load of particularly odorous material be received at the LLCS Cell, it will be buried immediately under day cover to minimise the impact to site workers and the possibility of the odour impacting the nearest sensitive receptors.

Site operators will be trained in the use of monitoring equipment prior to the first receipt of LLCS or LTPR at the site.

XX.3.1.2 Routine Odour Monitoring

The current LEMP identifies the routine odour monitoring required for the balefill site. This will be extended to the LLCS, with monitoring to be undertaken using a landfill gas monitor or similar to monitor the site for gases and vapors. All requirements for the keeping of records required by the LEMP shall be extended to include the LLCS Cells.

XX.3.1.3 LLCS Cell OHS

A policy will be developed for the OHS of all staff working on the cell. Training of staff will be developed following the development of this policy.

XX.3.2 Noise

The 2002 assessment of potential noise impacts from the landfill found that operations were within EPA' criteria for noise. As a result, IWS were granted permission by the EPA to extend operating hours.

The low level cell will not change the nature of current site operations. It is considered the same noise conditions will apply, and there will be no impact on surrounding properties.

XX.3.3 Dust

The low level cell will be visually monitored for dust generation during receipt of LLCS and LTPR. If dust is generated, immediate action will be taken to reduce this generation. Actions will be taken in accordance with Section 9.5 of the LEMP.

XX.4 Surface Water Management

Section 7 of the current LEMP details the surface water and drainage management procedures that are to be followed in accordance with the existing EPA Licence provisions. A draft Surface Water Management Plan has been prepared as part of the RRD. Following approval of the low level cells, the LEMP will be revised by the incorporation of this Surface Water Management Plan and any amendments required by EPA.

XX.5 Facilities Management

XX.5.1 Wheel Wash

The current wheel wash has been designed to minimise the export from the landfill site of soil and related materials which are in contact with the wheels of the waste transfer vehicles. As these vehicles will be confined to onsite roads, the majority of this material will be gravel road dust, although occasional accidental contact with wastes may occur close to the operating face of the landfill.

The current wheel wash has been designed as a water tight concrete containment basin with lift out grid 'shaker' panels made of steel. This basin is filled with water and as vehicles drive through, loose material and dust will be shaken and washed from the wheels.

An additional wheel wash facility of similar design will be constructed adjacent to the low level cells to clean the wheels of the waste transfer vehicles before they leave the environs of the low level cells.

Sediment from this wheel wash facility will periodically will be removed for disposal to the active low level cell. Water from the wheel wash will be used for dust suppression on the operating LLCS Cell, or disposed to a Licenced Treatment Facility.

XX.6 Closure and Post Closure Management

The low level cells will be managed in a similar manner to the balefill cells, as outlined in Section 16 of the current LEMP and Section 10 of the EIS Amendment; with the following additions:

- **Leachate**. During closure and post closure, monitoring of leachate in the low level cells would be undertaken in accordance with the methodology outlined in Section XX.2.2 above.

- **Groundwater.** During closure and post closure, monitoring of groundwater in the vicinity of the low level cells would be undertaken in accordance with the methodology outlined in Section XX.2.3 above.

Appendix D

Additional Data on HDPE Membrane

Hirst, Gary

From: Haynes, Calandra
Sent: Thursday, 6 November 2003 5:19 PM
To: Hirst, Gary
Subject: GH_Let061103

Letter attached.

Our Reference 2102250A/Haynes, Calandra

6th November 2003

Joe Borrelli
Integrated Waste Services Pty Ltd
Lot 254 Hines & Wingfield Roads
Wingfield SA 5013
Dear Joe

Additional Information on HDPE Geomembrane for IWS Balefill

Attached is some additional information on the chemical resistance of HDPE geomembranes as specified in the design of the IWS Balefill for the receipt of Low Level Contaminated Soil and Liquid Treatment Plant Residues. This information is intended to address the comments raised about the durability of the lining system in the conditions expected to occur in the Balefill, in particular, the potential impact of chemicals on the lining membrane.

Technical information on the liners, provided by the suppliers, indicate that they appear to be resistant to a great number and combination of chemicals (see attached brochure).

It should also be noted that additional protection is to be provided by a geotextile protector manufactured from polypropylene as outlined in the EIS Amendment. This provides improved strength over polyethylene and will ensure the contaminated soils do not come into direct contact with the geomembrane. It is important to stress that polypropylene provides equal protection chemically as polyethylene made products, the difference being polyproylene resins/fibres are stronger. The leachates which may contain some volatile hydrocarbons are likely to pose little risk to loss of integrity of the geomembrane as they are likely to be in sufficiently low concentrations in accordance with the low level contaminated soil criteria.

In addition the geomembrane will not be subject to high tensile loads eg on slopes, as the slope angles and slope lengths are not great for this cell. Therefore, any environmental stress cracking is not likely to occur as the stresses are low to start with. The integrity of the geomembrane will not be jeopardised.

Yours Sincerely

Gary Hirst
Parsons Brinckerhoff Australia

Chemical Resistance

*For environmental lining solutions ... the world comes to GSE.**

GSE is the world's leading supplier of high quality, polyethylene geomembranes. GSE polyethylene geomembranes are resistant to a great number and combinations of chemicals. Note that the effect of chemicals on any material is influenced by a number of variable factors such as temperature, concentration, exposed area and duration. Many tests have been performed that use geomembranes and certain specific chemical mixtures. Naturally, however, every mixture of chemicals cannot be tested for, and various criteria may be used to judge performance. Reported performance ratings may not apply to all applications of a given material in the same chemical. Therefore, these ratings are offered as a guide only.

Abbreviations

S = Satisfactory
L = Limited application possible
U = Unsatisfactory
— = Not tested

Concentration
sat. sol. = Saturated aqueous solution, prepared at 20°C (68°F)
sol. = aqueous solution with concentration above 10% but below saturation level
dil. sol. = diluted aqueous solution with concentration below 10%
cust. conc. = customary service concentration

Medium	Concentration	Resistance at: 20 °C (68 °F)	60 °C (140 °F)
A			
Acetic acid	100%	S	L
Acetic acid	10%	S	S
Acetic acid anhydride	100%	S	L
Acetone	100%	L	L
Adipic acid	sat. sol.	S	S
Allyl alcohol	96%	S	S
Aluminum chloride	sat. sol.	S	S
Aluminum fluoride	sat. sol.	S	S
Aluminum sulfate	sat. sol.	S	S
Alum	sol.	S	S
Ammonia, aqueous	dil. sol.	S	S
Ammonia, gaseous dry	100%	S	S
Ammonia, liquid	100%	S	S
Ammonium chloride	sat. sol.	S	S
Ammonium fluoride	sol.	S	S
Ammonium nitrate	sat. sol.	S	S
Ammonium sulfate	sat. sol.	S	S
Ammonium sulfide	sol.	S	S
Amyl acetate	100%	S	L
Amyl alcohol	100%	S	L
Aniline	100%	S	L
Antimony trichloride	90%	S	S
Arsenic acid	sat. sol.	S	S
Aqua regia	HCl-HNO33/1	U	U
B			
Barium carbonate	sat. sol.	S	S
Barium chloride	sat. sol.	S	S
Barium hydroxide	sat. sol.	S	S
Barium sulfate	sat. sol.	S	S
Barium sulfide	sol.	S	S
Benzaldehyde	100%	S	L
Benzene	—	L	L
Benzoic acid	sat. sol.	S	S
Beer	—	S	S
Borax (sodium tetraborate)	sat. sol.	S	S
Boric acid	sat. sol.	S	S
Bromine, gaseous dry	100%	U	U
Bromine, liquid	100%	U	U
Butane, gaseous	100%	S	S
1-Butanol	100%	S	S
Butyric acid	100%	S	L
C			
Calcium carbonate	sat. sol.	S	S
Calcium chlorate	sat. sol.	S	S
Calcium chloride	sat. sol.	S	S
Calcium nitrate	sat. sol.	S	S
Calcium sulfate	sat. sol.	S	S
Calcium sulfide	dil. sol.	L	L
Carbon dioxide, gaseous dry	100%	S	S
Carbon disulfide	100%	L	U
Carbon monoxide	100%	S	S
Chloracetic acid	sol.	S	S
Carbon tetrachloride	100%	L	U
Chlorine, aqueous solution	sat. sol.	L	U
Chlorine, gaseous dry	100%	L	U
Chloroform	100%	U	U
Chromic acid	20%	S	L
Chromic acid	50%	S	L
Citric acid	sat. sol.	S	S
Copper chloride	sat. sol.	S	S
Copper nitrate	sat. sol.	S	S
Copper sulfate	sat. sol.	S	S
Cresylic acid	sat. sol.	L	—
Cyclohexanol	100%	S	S
Cyclohexanone	100%	S	L
D			
Decahydronaphthalene	100%	S	L
Dextrine	sol.	S	S
Diethyl ether	100%	L	—
Dioctylphthalate	100%	S	L
Dioxane	100%	S	S
E			
Ethanediol	100%	S	S
Ethanol	40%	S	L
Ethyl acetate	100%	S	U
Ethylene trichloride	100%	U	U
F			
Ferric chloride	sat. sol.	S	S
Ferric nitrate	sol.	S	S
Ferric sulfate	sat. sol.	S	S
Ferrous chloride	sat. sol.	S	S
Ferrous sulfate	sat. sol.	S	S
Fluorine, gaseous	100%	U	U
Fluorosilicic acid	40%	S	S
Formaldehyde	40%	S	S
Formic acid	50%	S	S
Formic acid	98-100%	S	S
Furfuryl alcohol	100%	S	L
G			
Gasoline	—	S	L
Glacial acetic acid	96%	S	L
Glucose	sat. sol.	S	S
Glycerine	100%	S	S
Glycol	sol.	S	S
H			
Heptane	100%	S	U
Hydrobromic acid	50%	S	S

(CONTINUED ON OTHER SIDE)

(S) Satisfactory: *Liner material is resistant to the given reagent at the given concentration and temperature. No mechanical or chemical degradation is observed.*
(L) Limited Application Possible: *Liner material may reflect some attack. Factors such as concentration, pressure and temperature directly affect liner performance against the given media. Application, however, is possible under less severe conditions, e.g. lower concentration, secondary containment, additional liner protection, etc.*
(U) Unsatisfactory: *Liner material is not resistant to the given reagent at the given concentration and temperature. Mechanical and/or chemical degradation is observed.*
(–) Not tested

Medium	Concentration	Resistance at: 20 °C (68 °F)	60 °C (140 °F)
Hydrobromic acid	100%	S	S
Hydrochloric acid	10%	S	S
Hydrochloric acid	35%	S	S
Hydrocyanic acid	10%	S	S
Hydrofluoric acid	4%	S	S
Hydrofluoric acid	60%	S	L
Hydrogen	100%	S	S
Hydrogen peroxide	30%	S	L
Hydrogen peroxide	90%	S	U
Hydrogen sulfide, gaseous	100%	S	S
L			
Lactic acid	100%	S	S
Lead acetate	sat. sol.	S	—
M			
Magnesium carbonate	sat. sol.	S	S
Magnesium chloride	sat. sol.	S	S
Magnesium hydroxide	sat. sol.	S	S
Magnesium nitrate	sat. sol.	S	S
Maleic acid	sat. sol.	S	S
Mercuric chloride	sat. sol.	S	S
Mercuric cyanide	sat. sol.	S	S
Mercuric nitrate	sol.	S	S
Mercury	100%	S	S
Methanol	100%	S	S
Methylene chloride	100%	L	—
Milk	—	S	S
Molasses	—	S	S
N			
Nickel chloride	sat. sol.	S	S
Nickel nitrate	sat. sol.	S	S
Nickel sulfate	sat. sol.	S	S
Nicotinic acid	dil. sol.	S	—
Nitric acid	25%	S	S
Nitric acid	50%	S	U
Nitric acid	75%	U	U
Nitric acid	100%	U	U
O			
Oils and Grease	—	S	L
Oleic acid	100%	S	L
Orthophosphoric acid	50%	S	S
Orthophosphoric acid	95%	S	L
Oxalic acid	sat. sol.	S	S
Oxygen	100%	S	L
Ozone	100%	L	U
P			
Petroleum (kerosene)	—	S	L
Phenol	sol.	S	S
Phosphorus trichloride	100%	S	L
Photographic developer	conc. conc.	S	S
Picric acid	sat. sol.	S	—
Potassium bicarbonate	sat. sol.	S	S
Potassium bisulfide	sol.	S	S
Potassium bromate	sat. sol.	S	S
Potassium bromide	sat. sol.	S	S
Potassium carbonate	sat. sol.	S	S
Potassium chlorate	sat. sol.	S	S
Potassium chloride	sat. sol.	S	S
Potassium chromate	sat. sol.	S	S
Potassium cyanide	sol.	S	S
Potassium dichromate	sat. sol.	S	S
Potassium ferricyanide	sat. sol.	S	S
Potassium ferrocyanide	sat. sol.	S	S
Potassium fluoride	sat. sol.	S	S
Potassium hydroxide	10%	S	S
Potassium hydroxide	sol.	S	S
Potassium hypochlorite	sol.	S	L
Potassium nitrate	sat. sol.	S	S
Potassium orthophosphate	sat. sol.	S	S
Potassium perchlorate	sat. sol.	S	S
Potassium permanganate	20%	S	S
Potassium persulfate	sat. sol.	S	S
Potassium sulfate	sat. sol.	S	S
Potassium sulfite	sol.	S	S
Propionic acid	50%	S	S
Propionic acid	100%	S	L
Pyridine	100%	S	L
Q			
Quinol (Hydroquinone)	sat. sol.	S	S
S			
Salicylic acid	sat. sol.	S	S
Silver acetate	sat. sol.	S	S
Silver cyanide	sat. sol.	S	S
Silver nitrate	sat. sol.	S	S
Sodium benzoate	sat. sol.	S	S
Sodium bicarbonate	sat. sol.	S	S
Sodium biphosphate	sat. sol.	S	S
Sodium bisulfite	sol.	S	S
Sodium bromide	sat. sol.	S	S
Sodium carbonate	sat. sol.	S	S
Sodium chlorate	sat. sol.	S	S
Sodium chloride	sat. sol.	S	S
Sodium cyanide	sat. sol.	S	S
Sodium ferricyanide	sat. sol.	S	S
Sodium ferrocyanide	sat. sol.	S	S
Sodium fluoride	sat. sol.	S	S
Sodium hydroxide	40%	S	S
Sodium hydroxide	sat. sol.	S	S
Sodium hypochlorite	15% active chlorine	S	S
Sodium nitrate	sat. sol.	S	S
Sodium nitrite	sat. sol.	S	S
Sodium orthophosphate	sat. sol.	S	S
Sodium sulfate	sat. sol.	S	S
Sodium sulfide	sat. sol.	S	S
Sulfur dioxide, dry	100%	S	S
Sulfur trioxide	100%	U	U
Sulfuric acid	10%	S	S
Sulfuric acid	50%	S	S
Sulfuric acid	98%	S	U
Sulfuric acid	fuming	U	U
Sulfurous acid	30%	S	S
T			
Tannic acid	sol.	S	S
Tartaric acid	sol.	S	S
Thionyl chloride	100%	L	U
Toluene	100%	L	U
Triethylamine	sol.	S	L
U			
Urea	sol.	S	S
Urine	—	S	S
W			
Water	—	S	S
Wine vinegar	—	S	S
Wines and liquors	—	S	S
X			
Xylenes	100%	L	U
Y			
Yeast	sol.	S	S
Z			
Zinc carbonate	sat. sol.	S	S
Zinc chloride	sat. sol.	S	S
Zinc (II) chloride	sat. sol.	S	S
Zinc (IV) chloride	sat. sol.	S	S
Zinc oxide	sat. sol.	S	S
Zinc sulfate	sat. sol.	S	S

Specific immersion testing should be undertaken to ascertain the suitability of chemicals not listed above with reference to special requirements.

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TC 001 R02/05/98

Appendix E

HELP Modelling

Dublin Landfill

Hydrologic Evaluation of Landfill Performance (HELP) Modelling (Revised)

29 January 2004

Integrated Waste Services

PARSONS BRINCKERHOFF

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Signed: .....

Date: ..... 29 January 2004

Distribution: ..... SA Govt. (5), PB Adelaide (3), IWS (3)

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1. Introduction

Following the first report compiled by Parsons Brinckerhoff Australia Pty Ltd (PB) on numerical modelling of the performance of the proposed contaminated soil landfill cell at the IWS Northern Balefill in Dublin, SA (PB, 2003), the South Australian Department of Transport and Urban Planning raised various issues with the modelling (detailed in the email received from them, contained in Appendix A).

This report presents the results of additional modelling to address the issues raised. The results that are presented, and the format of the report, differ from the previous report.

The QA/QC requirements of the lining system were detailed in Section 4 of the previous report (PB, 2003) and are not repeated here. Refer to the previous report for those requirements.

1.1 Scope of Report

The scope of this study comprised the estimation, through the use of numerical modelling, of:

1 The amount of leachate that will be produced by the landfill during filling and post-closure; and

2 The amount of leachate (if any) that will migrate down through the secondary clay liner and into the surrounding soils.

To achieve this, the USEPA/USACE Hydrologic Evaluation of Landfill Performance (HELP) Model was used to calculate water budgets for three scenarios as follows:

- **Scenario 1: During Operation (Uncapped Waste)**. This scenario assumes the waste remains essentially uncapped, apart from the provision of daily cover to the wastes. Based on an estimated annual waste input of 20,000 tonnes per annum, it is estimated that the cell may be operational for up to nine years.
- **Scenario 2: Post-Closure, with no geosynthetic drainage layer underneath restoration soils**. In this scenario, post-closure capping of the landfill has been completed with 1m of restoration soils at the surface underlain by 0.6m of Barrier Soil (the clay cap). No geosynthetic drainage layer (GDL) exists between these top two layers.
- **Scenario 3: Post-Closure, with a geosynthetic drainage layer underneath restoration soils**. In this scenario, post-closure capping of the landfill has been completed with 1m of restoration soils at the surface underlain by a GDL of 5mm thickness. The GDL is underlain by 0.6m of Barrier Soil (the clay cap). The GDL is included to reduce vertical percolation by providing increased lateral drainage above the clay cap.

The following annual water budget totals, over 50 years of simulation, have been calculated:

- Lateral drainage from the GDL underlying the restoration soils (Scenario 3 only);
- Vertical percolation through the Barrier Soil and into the waste mass (Scenarios 2 and 3 only);
- Lateral drainage from the Primary Leachate Collection and Control System (LCCS);
- Lateral drainage from the Secondary LCCS; and
- Vertical percolation through the Secondary Clay Liner.

1.2 Numerical Model

The performance of the landfill has been evaluated by using the Hydrologic Evaluation of Landfill Performance (HELP) model. This is a numerical algorithm developed by the USACE in conjunction with the USEPA. The model is used by many authorities world-wide in evaluation of landfill performance.

The algorithm simulates what is commonly known as a "1.5-dimensional" system, as follows:

- Solution of the one-dimensional vertical saturated / unsaturated flow problem through a set of hydraulically coupled layers.
- Solution of the one-dimensional lateral flow problem through specifically defined layers using a set of equations that are not coupled to solution of the vertical flow problem.

2. Landfill Geometry

The plan area of the landfill has been estimated as 1.525ha (based on Drawing "DO2-5_210225A", dated 21 March 2003). It is approximately square in shape with a curved south-eastern boundary.

2.1 Layering

The nominal landfill layering (according to the proposed design) is shown in Table 2.1. The following should be noted:

- Scenario 3 incorporates all layers in Table 2.1 except the polypropylene (PP) protective blanket.
- Scenario 2 incorporates all layers in Table 2.1 except the PP protective blanket and the GDL underlying the restoration soils.
- Scenario 1 incorporates all layers in Table 2.1 except the PP protective blanket and the top three layers.
- The hydraulic conductivities listed in Table 2.1 are for the Base Case, defined as the nominal permeability requirements. A sensitivity analysis was conducted whereby these parameters were varied for selected layers (see Section 4).

The primary lining system at the base of the waste consists of a high-density polyethylene (HDPE) geomembrane of 1.5mm thickness underlain by a 600mm liner of reworked compacted clay. For modelling purposes, the geomembrane is assumed to have 2 pinholes per ha, 2 installation defects per ha, and a placement quality of 4 (poor contact between the geomembrane and adjacent soil), as defined in the previous report (PB, 2003).

The geomembrane is overlain by the Primary LCCS which consists of a gravel layer that drains to a collection sump. The gravel hosts a series of spine drains to control the head of leachate on the membrane and facilitate drainage to the sump.

The PP protective blanket that is to be placed between the Primary LCCS and geomembrane will protect the geomembrane from puncture and minimise its long term deformation. The blanket consists of a non-woven staple fibre needle-punched polypropylene geotextile that does not drain to a sump. This layer is not included in the simulations for the following reasons:

- HELP permits a geomembrane to be overlain only by another geomembrane or lateral drainage layer.
- The purpose of the protective blanket is neither to drain leachate nor provide a barrier to flow. To model the protective blanket as a lateral drainage layer would require either specification of zero drainage length and zero slope (with unknown numerical effects) or specification of a non-zero drainage length with 100% of the drainage recirculated back into the protective blanket layer (with possible artificial head fluctuations).

- To model the protective blanket as a geomembrane would require estimation of surrogate estimates of defects and vapour diffusion permeability as a substitute for its permeability and storage characteristics.
- The effect of the protective blanket on the hydrodynamics of the landfill is expected to be minimal. Its inclusion could therefore not be justified due to the complexity required for its simulation.

The GDL used for lateral drainage between the Restoration Soils and Barrier Soil (Scenario 2) and for the Secondary LCCS (all scenarios) consists of a HDPE drainage net core placed between two separator geotextiles. The GDL is understood to transmit any leaked fluids to a perimeter drain.

A summary model report of parameters used by the model for the Base Case simulation for each scenario is provided in Appendix B.

2.2 Drainage Slopes

The HELP model requires information on layer slope and "drainage length" only for the surface of the top layer and for the bases of lateral drainage layers. The "Geotextiles and Geonets" layer option offered in Visual HELP is in fact defined as a lateral drainage layer with appropriate storage characteristics.

For the top layer, these parameters are required so that surface runoff at the runoff boundary (defined by the "drainage length") can be calculated. For lateral drainage layers, these parameters are required so that lateral flow to the flux boundary (defined by the "drainage length") can be calculated.

Runoff is calculated using the SCS curve number method. In this study, the curve number has been calculated by the model according to the prescribed slope, drainage length, material, and vegetative cover of the top layer.

Table 2.2 lists the slope parameters provided to the model for the relevant layers. These were not changed during the sensitivity analysis of model parameters.

During filling of the landfill, surface runoff from the entire operational area of the landfill is assumed to report to a single sump. The surface runoff is classified as leachate, and it is understood that no recirculation of this leachate (by re-application to the waste) will be conducted.

Table 2.1: Nominal Landfill Layering

Dublin Landfill Layer Name	Material Type	HELP Model Layer Type	Thickness (m)	Hydraulic Conductivity in appropriate direction (m/s)	Total Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	Presence of the layer in each scenario		
								Scenario 1	Scenario 2	Scenario 3
Restoration Soils	Silty Loam for vegetative stand	Vertical Percolation	1	1.9×10^{-6}	0.501	0.284	0.135		X	X
Geosynthetic Drainage Layer	High transmissivity HDPE core between PP geotextiles	Geotextile (Lateral Drainage)	0.005	1.0×10^{-2}	0.850	0.010	0.005			X
Barrier Soil	High density liner soil (compacted clay)	Barrier Soil	0.6	1.0×10^{-9}	0.427	0.418	0.367		X	X
Waste (LLCS and LTPR)	Waste	Vertical Percolation	13.4	5.2×10^{-6}	0.473	0.222	0.104	X	X	X
Primary LCCS	Gravel	Lateral Drainage	0.3	1.0×10^{-3}	0.397	0.032	0.013	X	X	X
HDPE Membrane Protective Blanket	PP Geotextile Protective Blanket		0.005							
High Density Polyethylene	HDPE membrane	Geomembrane	0.0015	2.0×10^{-15} *	NA	NA	NA	X	X	X
Primary Clay Liner	High density liner soil (compacted clay)	Barrier Soil	0.6	1.0×10^{-9}	0.427	0.418	0.367	X	X	X
Secondary LCCS	High transmissivity HDPE core between PP geotextiles	Geotextile (Lateral Drainage)	0.005	1.0×10^{-2}	0.850	0.010	0.005	X	X	X
Secondary Clay Liner	High density liner soil (compacted clay)	Barrier Soil	0.6	1.0×10^{-9}	0.427	0.418	0.367	X	X	X

* Vapour diffusion permeability.

Table 2.2: Runoff / Lateral Drainage Parameters

Layer	Parameter	Scenario 1	Scenario 2	Scenario 3
Landfill surface	Slope (%)	2	10	10
	Drainage Length (m)	55	55	55
GDL under Restoration Soils	Slope (%)	NA	NA	10
	Drainage Length (m)	NA	NA	55
Primary LCCS	Slope (%)	2	2	2
	Drainage Length (m)	20	20	20
Secondary LCCS	Slope (%)	2	2	2
	Drainage Length (m)	55	55	55

3. Weather Data

Each scenario was simulated for a period of 50 years. Note that Scenario 1 is not expected to last for more than 9 years, however a 50 year run is used to observe performance over a range of weather conditions that are likely to be represented in a 50 year rainfall data set.

The data sets for all required weather inputs (rainfall, solar radiation, temperature, wind speed, humidity) have been synthesised by Visual HELP using an extensive set of probabilistic coefficients obtained from weather data recorded between 1977 and 1991 at a weather station located in Adelaide.

3.1 Rainfall

Since the most important input to the HELP model, apart from layer geometry, is the weather data set, the annual rainfall totals for the 50 years of daily rainfall synthesised by Visual HELP have been compared to the annual totals of daily rainfall recorded at the Lower Light rainfall station (Station 23007, located approximately 5km southeast of the landfill). It is assumed that the rainfall at Lower Light is a good indicator of the rainfall experienced at the location of the landfill.

Figure 3.1 shows the probability distributions of the real and synthesised data sets. The synthesised annual rainfall totals are slightly over-predicted during dry times, and slightly under-predicted during wet times, although the difference between the probability distributions is small. The probability functions are linear, so that the average rainfall is equivalent to the Decile 5 rainfall. The synthesised Decile 5 annual rainfall is greater than the real Decile 5 annual rainfall, which makes the model conservative in that simulated average annual leachate production will be slightly higher than if real rainfall data were used.

3.2 Other Weather Data

The synthesised annual totals / averages for solar radiation and temperature are good representations of real data, due to more rhythmical fluctuation in these sets compared to rainfall. Comparison of 10 years of real global radiation and diffuse radiation data for Adelaide Airport over the period 1983 to 1992 with synthesised data indicated excellent agreement.

Annual / seasonal averages for wind speed and humidity were also considered to be adequately represented.

3.3 Evaporative Zone Depth

The evaporative zone depth (EZD) is the maximum depth from which water may be removed by evapotranspiration, and must be estimated and provided as input to the

model. The HELP model is known to be highly sensitive to this parameter, as it substantially affects the volume of water that penetrates the first layer and enters the landfill, especially in arid regions. One major factor influencing the EZD is the depth of root penetration, which for native grasses of South Australia is likely to be approximately 0.5m.

In the current study, an EZD of 25cm has been specified for the waste (Scenario 1) and 40cm has been specified for Restoration Soils (Scenarios 2 and 3). The EZD for the Restoration Soils was also a subject of the sensitivity analysis.

4. Sensitivity Analysis

A selection of the parameters listed in Table 2.1 (comprising the layering for each scenario of the Base Case) was the subject of a sensitivity analysis to observe the effect on model output from changes in these parameters.

The sensitivity analysis consisted of variations in three parameters as specified in Table 4.1. These were considered to be some of the most significant layer parameters operating on the generation of leachate. No two parameters were simultaneously perturbed.

Table 4.1: Parameters Subjected to Sensitivity Analysis

Parameter	Base Case Value	Perturbed Value
Hydraulic conductivity of the clay liner (as used for the Barrier Soil, Primary Clay Liner, and Secondary Clay Liner) (m/s)	1×10^{-9}	5×10^{-9}
Hydraulic conductivity of the Primary LCCS (m/s)	1×10^{-3}	1×10^{-4}
Evaporative Zone Depth of Restoration Soils (cm)	40	20

5. Simulation Results

The average and maximum annual total, over 50 years of simulation, have been calculated for the following components of the water budget for the landfill:

- Lateral drainage from the GDL underlying the Restoration Soils (Scenario 3 only);
- Vertical percolation through the Barrier Soil and into the waste mass (Scenarios 2 and 3 only);
- Lateral drainage from the Primary LCCS;
- Lateral drainage from the Secondary LCCS; and
- Vertical percolation through the Secondary Clay Liner.

These water budget components have been calculated for all three scenarios for the Base Case simulations, and for each of the perturbed parameter simulations. All results are listed in Table 5.1.

Figures showing the annual totals over the period of simulation are contained in the following appendices:

- Appendix C: Base Case
- Appendix D: Clay liner with higher hydraulic conductivity
- Appendix E: Primary LCCS with lower hydraulic conductivity
- Appendix F: Restoration Soils with a shallower Evaporative Zone Depth

5.1 Generated Leachate

The highest annual total leachate volumes are generated during the operational period by the Primary LCCS. The Secondary LCCS contributes negligible leachate for all scenarios.

Generated annual leachate volumes during the operational phase range between approximately 600 and 1000m^3/year (2 to 3m^3/day). For other scenarios, annual leachate volumes range between approximately 20 and 700m^3/year, or about 0.05 to 2m^3/day.

Annual runoff volumes generated in Scenario 1 for all cases (Base Case and lower hydraulic conductivity of Primary LCCS) were nil for every year. In this scenario, incident rainfall volumes that did not infiltrate down past the EZD were removed by evaporation. Inspection of the daily model output for a selected set of years indicated that, in those years, no water ponding occurred at the surface of the waste.

The upper GDL (between the Restoration Soils and Barrier Soil) is efficient at intercepting infiltrating rainwater, and typically reduces the leachate collected by the Primary LCCS by about 50%. For the case where the EZD is shallower, the upper GDL

typically intercepts a volume equivalent to 80 to 90% of the total generated leachate. Note that water intercepted by the upper GDL is not considered leachate.

A shallower evaporative zone increases the amount of leachate generated. A halving of the EZD for the Restoration Soils caused an approximate doubling of:

- the generated annual average leachate for Scenario 2; and
- the generated annual average drainage from the upper GDL for Scenario 3.

5.2 Impact on the Environment

Annual total volumes of leachate leaking down past the Secondary Clay Liner are less than $1m^3$/year for all scenarios in all cases. This volume is negligible, and no impact on the surrounding soils is expected.

Table 5.1: Simulation Results

Case	Scenario		Average Head on Membrane (m)	Drainage from Geosynthetic Drainage Layer (m^3/year)	Leakage through Barrier Soil (m^3/year)	Drainage from Primary LCCS (m^3/year)	Drainage from Secondary LCCS (m^3/year)	Leakage through Secondary Clay Liner (m^3/year)
Base Case	Uncapped Waste	Average	0.001	NA	NA	599	0.0	0.0
		Maximum	0.001	NA	NA	943	0.0	0.0
	Post-Closure (no upper drainage layer)	Average	0.000	NA	134	122	0.0	0.0
		Maximum	0.000	NA	546	479	0.0	0.0
	Post-Closure (with upper drainage layer)	Average	0.000	114	20	20	0.0	0.0
		Maximum	0.000	802	105	105	0.0	0.0
Clay liner with higher hydraulic conductivity	Post-Closure (no upper drainage layer)	Average	0.000	NA	134	132	0.0	0.0
		Maximum	0.001	NA	906	767	0.0	0.0
	Post-Closure (with upper drainage layer)	Average	0.000	58	76	76	0.0	0.0
		Maximum	0.000	515	460	336	0.0	0.0
Primary LCCS with lower hydraulic conductivity	Uncapped Waste	Average	0.006	NA	NA	599	0.0	0.2
		Maximum	0.010	NA	NA	947	0.0	0.3
	Post-Closure (no upper drainage layer)	Average	0.001	NA	134	122	0.0	0.0
		Maximum	0.005	NA	546	488	0.0	0.1
	Post-Closure (with upper drainage layer)	Average	0.000	114	20	20	0.0	0.0
		Maximum	0.001	802	105	105	0.0	0.0
Restoration Soils with a shallower Evaporative Zone Depth	Post-Closure (no upper drainage layer)	Average	0.000	NA	377	361	0.0	0.0
		Maximum	0.001	NA	652	774	0.0	0.0
	Post-Closure (with upper drainage layer)	Average	0.000	314	58	58	0.0	0.0
		Maximum	0.000	1144	154	154	0.0	0.0

6. Conclusions

A HELP model simulation has been conducted for the Dublin Landfill to incorporate issues raised by Planning SA. Based on the assumptions and parameters used in the modelling, the following conclusions are made:

- Overall annual leachate generation volumes are small compared to other landfills in Australia, and would rarely exceed 1000m^3/year. Over the 50 year period of sumulation, soil moisture storage volumes did not accumulate but varied around an equilibrium storage.
- The impact on soils and groundwater outside the landfill, from leachate generated in the landfill, is expected to be negligible.

The upper GDL can significantly reduce the amount of generated leachate by intercepting relatively clean water prior to infiltrating into the waste mass. Since the magnitude of the generated leachate is small in any case, the cost of managing this leachate in the long term may be comparable to the cost (and possible risk) associated with the installation of an upper GDL.

The performance of the landfill is sensitive to the EZD, but for the EZD of 40cm for the Restoration Soils for the Base Case is considered conservatively small, thereby over-estimating long-term generated leachate volumes.

7. Discussion

The parameters used in the HELP model are considered representative of long term physical conditions, and the design of the landfill is considered to perform well based on these parameters. However the HELP model is sensitive to several of the assumptions as follows:

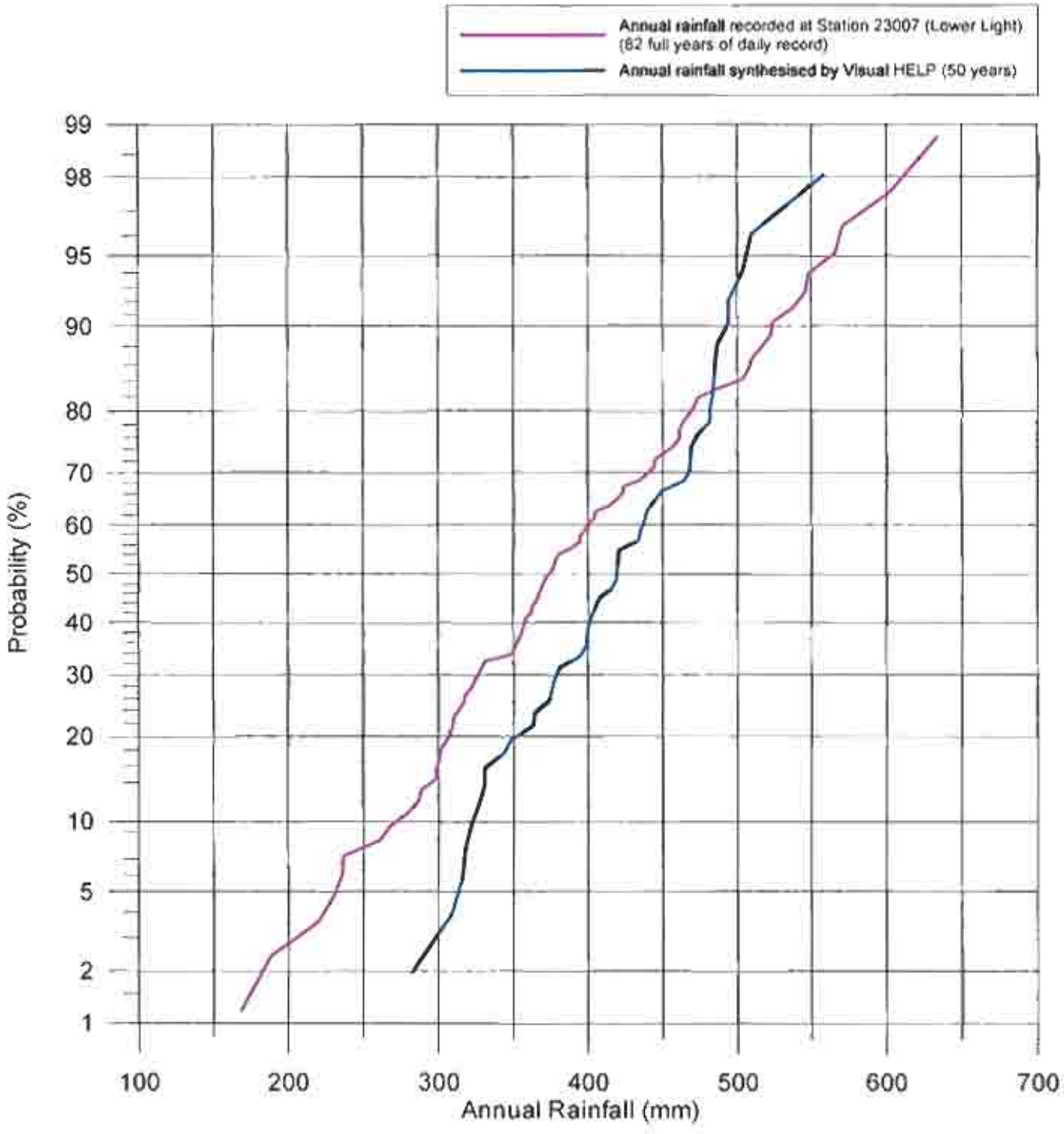
- The Primary LCCS has the propensity to clog with fines leached from the waste mass, chemical precipitation, and growth of bacterial slimes. This will reduce its permeability, however information on actual long-term permeabilities for gravel drainage layers in landfills is sparse. Experience with landfills in eastern Australia would indicate a hydraulic conductivity of about 1 to 10m/day (approximately 1 $x10^{-5}$ to 1 x 10^{-4} m/s) might be achieved in the long term, for an originally clean gravel layer having an initial hydraulic conductivity of 1 x 10^{-3} m/s at installation.
- The actual head of leachate on the geomembrane will depend on the head of leachate in the sump. The simulation results in model-calculated negligible hydraulic heads on the geomembrane due to the assumption that the leachate level in the sump is always below the lowest point of the geomembrane. In reality, the head of leachate in the sump may be above the lowest point of the geomembrane at times (depending on licence conditions and operational practices), which would increase the head of leachate on the geomebrane.
- The simulation has assumed that no leachate is recirculated to the waste for the uncapped scenario. If recirculation does occur, the hydrodynamics of the landfill are affected, most notably resulting in higher heads and soil moisture storage volumes in the waste and underlying layers.

8. References

PB. 2003. Hydrologic Evaluation of Landfill Performance (HELP) Modelling & Quality Control Procedures for Proposed Lining System. Report No. 03-0785-01. November.

Figures

PARSONS BRINCKERHOFF



Annual Rainfall Probability Distributions
Adelaide SA

Figure 3.1

Appendix A

Issues Raised by the South Australian Department of Transport and Urban Planning

-----Original Message-----
From: Eadie, Alexander (PLNSA) [mailto:Eadie.Alexander@saugov.sa.gov.au]
Sent: Tuesday, December 16, 2003 8:31 AM
To: 'rhodges@pb.com.au'
Cc: 'jcorbett@pb.com.au'
Subject: IWS

Russell,

I think there should be a check done on the parameters used in the HELP modelling (Appendix C) as many do not seem to be consistent with values that should be used.

* the HDPE liner thickness in the text and design is 1.5 mm thick, but the modelling used 1 mm.
* Table 3.1 has a permeability of the restoration soils of 5.2X 10-6 m/s, but modelling uses 1.9 X 10-6 m/s
* The thicknesses and permeability of the geomembrane and secondary leachate collection system in Table 3.1 are incorrect.
* section 4.9.2 of Appendix D refers to a transmissivity of the secondary drainage layer (geonet) of 0.5 X10 -4 m/s2, which translates to a permeability of 0.01 m/s. The modelling used a permeability of 0.1 m/s (10 cm/s).
* the drainage layer permeability (primary leachate collection system) was modelled using 3X 10 -5 m/s (3x10-3 cm/s). This is at variance to the EPA requirement of 1X10-3 m/s.
* The barrier soil has been modelled with permeability of 1X10-8 m/s, when usually use 1X10-9 m/s. Although I can understand this departure as there may be difficulty in achieving 1X10-9 for compacted clay placed on waste.
* The primary clay layer has been modelled at 1.7X10-7 m/s as opposed to the commonly accepted 1X10-9 m/s and as referred to in Table 3.1.
* Similarly the secondary clay liner has been modelled at 1X10-8 m/s as opposed to the normal value of 1X10-9 m/s and as refereed to in Table 3.1.

While it could be argued that use of the incorrect numbers would have resulted in overestimation of the seepage volumes, I think it is important for the correct parameters to be used. The modelling should be undertaken with the correct values.

Regards,

Alex Eadie
Principal Environmental Officer
Assessment Branch, Planning SA
Department of Transport and Urban Planning

Email: eadie.alexander@saugov.sa.gov.au
Phone: (08) 8303 0746
Fax: (08) 8303 0753

Appendix B

Model-Generated Report Listing
Base Case Layer Parameters

Project: Dublin Landfill

Simulation of IWS Northern Balefill Proposed Landfill

Model: HELP

A US EPA model for predicting landfill hydrologic processes and testing of effectiveness of landfill designs

Client: Integrated Waste Services

Location: IWS Northern Balefill, Dublin, SA

27/01/2004

1. Profile: Profile 1. Clay Cap - No Upper Drainage Layer

Model Settings

[HELP] Case Settings

Parameter	Value	Units
Runoff Method	Model calculated	(-)
Initial Moisture Settings	Model calculated	(-)

[HELP] Surface Water Settings

Parameter	Value	Units
Runoff Area	80	(%%)
Vegetation Class	Fair stand of grass	(-)

Profile Structure

Layer	Top (m)	Bottom (m)	Thickness (m)
Restoration Soils	0.0000	-1.0000	1.0000
Dublin Barrier Soil	-1.0000	-1.6000	0.6000
Waste (LLCS and LTPR)	-1.6000	-15.0000	13.4000
Dublin Gravel	-15.0000	-15.3000	0.3000
High Density Polyethylene	-15.3000	-15.3015	0.0015
Primary Clay Liner	-15.3015	-15.9015	0.6000
Secondary LCCS	-15.9015	-15.9065	0.0050
Secondary Clay Liner	-15.9065	-16.5065	0.6000

1.1. Layer. Restoration Soils

Top Slope Length: 55.0000
Bottom Slope Length: 0.0000
Top Slope: 10.0000
Bottom Slope : 10.0000

[HELP] Vertical Perc. Layer Parameters

Parameter	Value	Units
total porosity	0.501	(vol/vol)
field capacity	0.284	(vol/vol)
wilting point	0.135	(vol/vol)
sat.hydr.conductivity	1.9E-4	(cm/sec)
subsurface inflow	0	(mm/year)

1.2. Layer. Barrier Soil

Top Slope Length: 0.0000
Bottom Slope Length: 0.0000
Top Slope: 10.0000
Bottom Slope : 10.0000

[HELP] Barrier Soil Liner Parameters

Parameter	Value	Units
total porosity	0.427	(vol/vol)
field capacity	0.418	(vol/vol)
wilting point	0.367	(vol/vol)
sat.hydr.conductivity	1E-7	(cm/sec)
subsurface inflow	0	(mm/year)

1.3. Layer. Waste (LLCS and LTPR)

Top Slope Length: 0.0000
Bottom Slope Length: 0.0000
Top Slope: 10.0000
Bottom Slope : 0.0000

[HELP] Vertical Perc. Layer Parameters

Parameter	Value	Units
total porosity	0.473	(vol/vol)
field capacity	0.222	(vol/vol)
wilting point	0.104	(vol/vol)
sat.hydr.conductivity	5.2E-4	(cm/sec)
subsurface inflow	0	(mm/year)

1.4. Layer. Primary LCCS

Top Slope Length: 0.0000
Bottom Slope Length: 20.0000
Top Slope: 0.0000
Bottom Slope : 2.0000

[HELP] Lateral Drainage Layer Parameters

Parameter	Value	Units
total porosity	0.397	(vol/vol)
field capacity	0.032	(vol/vol)
wilting point	0.013	(vol/vol)
sat.hydr.conductivity	0.1	(cm/sec)
subsurface inflow	0	(mm/year)

1.5. Layer. High Density Polyethylene

Top Slope Length: 20.0000
Bottom Slope Length: 20.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Geomembrane Liner Parameters

Parameter	Value	Units
sat.hydr.conductivity	2E-13	(cm/sec)
pinhole density	2	(#/ha)
installation defects	2	(#/ha)
placement quality	4	(-)
geotextile transmissivity	0	(cm2/sec)

1.6. Layer. Primary Clay Liner

Top Slope Length: 20.0000
Bottom Slope Length: 55.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Barrier Soil Liner Parameters

Parameter	Value	Units
total porosity	0.427	(vol/vol)
field capacity	0.418	(vol/vol)
wilting point	0.367	(vol/vol)
sat.hydr.conductivity	1E-7	(cm/sec)
subsurface inflow	0	(mm/year)

1.7. Layer. Secondary LCCS

Top Slope Length: 55.0000
Bottom Slope Length: 55.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Geotextiles and Geonets Parameters

Parameter	Value	Units
total porosity	0.85	(vol/vol)
field capacity	0.01	(vol/vol)
wilting point	0.005	(vol/vol)
sat.hydr.conductivity	1	(cm/sec)
subsurface inflow	0	(mm/year)

1.8. Layer. Secondary Clay Liner

Top Slope Length: 55.0000
Bottom Slope Length: 0.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Barrier Soil Liner Parameters

Parameter	Value	Units
total porosity	0.427	(vol/vol)
field capacity	0.418	(vol/vol)
wilting point	0.367	(vol/vol)
sat.hydr.conductivity	1E-7	(cm/sec)
subsurface inflow	0	(mm/year)

2. Profile: Profile 2. Uncapped Scenario

Model Settings

[HELP] Case Settings

Parameter	Value	Units
Runoff Method	Model calculated	(-)
Initial Moisture Settings	Model calculated	(-)

[HELP] Surface Water Settings

Parameter	Value	Units
Runoff Area	80	(%%)
Vegetation Class	Bare soil	(-)

Profile Structure

Layer	Top (m)	Bottom (m)	Thickness (m)
Waste (LLCS and LTPR)	0.0000	-13.4000	13.4000
Dublin Gravel	-13.4000	-13.7000	0.3000
High Density Polyethylene	-13.7000	-13.7015	0.0015
Primary Clay Liner	-13.7015	-14.3015	0.6000
Secondary LCCS	-14.3015	-14.3065	0.0050
Secondary Clay Liner	-14.3065	-14.9065	0.6000

2.1. Layer. Waste (LLCS and LTPR)

Top Slope Length: 55.0000
Bottom Slope Length: 0.0000
Top Slope: 2.0000
Bottom Slope : 0.0000

[HELP] Vertical Perc. Layer Parameters

Parameter	Value	Units
total porosity	0.473	(vol/vol)
field capacity	0.222	(vol/vol)
wilting point	0.104	(vol/vol)
sat.hydr.conductivity	5.2E-4	(cm/sec)
subsurface inflow	0	(mm/year)

2.2. Layer. Primary LCCS

Top Slope Length: 0.0000
Bottom Slope Length: 20.0000
Top Slope: 0.0000
Bottom Slope : 2.0000

[HELP] Lateral Drainage Layer Parameters

Parameter	Value	Units
total porosity	0.397	(vol/vol)
field capacity	0.032	(vol/vol)
wilting point	0.013	(vol/vol)
sat.hydr.conductivity	0.1	(cm/sec)
subsurface inflow	0	(mm/year)

2.3. Layer. High Density Polyethylene

Top Slope Length: 20.0000
Bottom Slope Length: 20.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Geomembrane Liner Parameters

Parameter	Value	Units
sat.hydr.conductivity	2E-13	(cm/sec)
pinhole density	2	(#/ha)
installation defects	2	(#/ha)
placement quality	4	(-)
geotextile transmissivity	0	(cm2/sec)

2.4. Layer. Primary Clay Liner

Top Slope Length: 20.0000
Bottom Slope Length: 55.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Barrier Soil Liner Parameters

Parameter	Value	Units
total porosity	0.427	(vol/vol)
field capacity	0.418	(vol/vol)
wilting point	0.367	(vol/vol)
sat.hydr.conductivity	1E-7	(cm/sec)
subsurface inflow	0	(mm/year)

2.5. Layer. Secondary LCCS

Top Slope Length: 55.0000
Bottom Slope Length: 55.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Geotextiles and Geonets Parameters

Parameter	Value	Units
total porosity	0.85	(vol/vol)
field capacity	0.01	(vol/vol)
wilting point	0.005	(vol/vol)
sat.hydr.conductivity	1	(cm/sec)
subsurface inflow	0	(mm/year)

2.6. Layer. Secondary Clay Liner

Top Slope Length: 55.0000
Bottom Slope Length: 0.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Barrier Soil Liner Parameters

Parameter	Value	Units
total porosity	0.427	(vol/vol)
field capacity	0.418	(vol/vol)
wilting point	0.367	(vol/vol)
sat.hydr.conductivity	1E-7	(cm/sec)
subsurface inflow	0	(mm/year)

3. Profile: Profile 3. Clay Cap - With Upper Drainage Layer

Model Settings

[HELP] Case Settings

Parameter	Value	Units
Runoff Method	Model calculated	(-)
Initial Moisture Settings	Model calculated	(-)

[HELP] Surface Water Settings

Parameter	Value	Units
Runoff Area	80	(%%)
Vegetation Class	Fair stand of grass	(-)

Profile Structure

Layer	Top (m)	Bottom (m)	Thickness (m)
Silty Loam	0.0000	-1.0000	1.0000
Geosynthetic Drainage Layer	-1.0000	-1.0050	0.0050
Dublin Barrier Soil	-1.0050	-1.6050	0.6000
Waste (LLCS and LTPR)	-1.6050	-15.0050	13.4000
Dublin Gravel	-15.0050	-15.3050	0.3000
High Density Polyethylene	-15.3050	-15.3065	0.0015
Primary Clay Liner	-15.3065	-15.9065	0.6000
Secondary LCCS	-15.9065	-15.9115	0.0050
Secondary Clay Liner	-15.9115	-16.5115	0.6000

3.1. Layer. Restoration Soils

Top Slope Length: 55.0000
Bottom Slope Length: 55.0000
Top Slope: 10.0000
Bottom Slope : 10.0000

[HELP] Vertical Perc. Layer Parameters

Parameter	Value	Units
total porosity	0.501	(vol/vol)
field capacity	0.284	(vol/vol)
wilting point	0.135	(vol/vol)
sat.hydr.conductivity	1.9E-4	(cm/sec)
subsurface inflow	0	(mm/year)

3.2. Layer. Geosynthetic Drainage Layer

Top Slope Length: 55.0000
Bottom Slope Length: 55.0000
Top Slope: 10.0000
Bottom Slope : 10.0000

[HELP] Geotextiles and Geonets Parameters

Parameter	Value	Units
total porosity	0.85	(vol/vol)
field capacity	0.01	(vol/vol)
wilting point	0.005	(vol/vol)
sat.hydr.conductivity	1	(cm/sec)
subsurface inflow	0	(mm/year)

3.3. Layer. Barrier Soil

Top Slope Length: 55.0000
Bottom Slope Length: 0.0000
Top Slope: 10.0000
Bottom Slope : 10.0000

[HELP] Barrier Soil Liner Parameters

Parameter	Value	Units
total porosity	0.427	(vol/vol)
field capacity	0.418	(vol/vol)
wilting point	0.367	(vol/vol)
sat.hydr.conductivity	1E-7	(cm/sec)
subsurface inflow	0	(mm/year)

3.4. Layer. Waste (LLCS and LTPR)

Top Slope Length: 0.0000
Bottom Slope Length: 0.0000
Top Slope: 10.0000
Bottom Slope : 0.0000

[HELP] Verlical Perc. Layer Parameters

Parameter	Value	Units
total porosity	0.473	(vol/vol)
field capacity	0.222	(vol/vol)
wilting point	0.104	(vol/vol)
sat.hydr.conductivity	5.2E-4	(cm/sec)
subsurface inflow	0	(mm/year)

3.5. Layer. Primary LCCS

Top Slope Length: 0.0000
Bottom Slope Length: 20.0000
Top Slope: 0.0000
Bottom Slope : 2.0000

[HELP] Lateral Drainage Layer Parameters

Parameter	Value	Units
total porosity	0.397	(vol/vol)
field capacity	0.032	(vol/vol)
wilting point	0.013	(vol/vol)
sat.hydr.conductivity	0.1	(cm/sec)
subsurface inflow	0	(mm/year)

3.6. Layer. High Density Polyethylene

Top Slope Length: 20.0000
Bottom Slope Length: 20.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Geomembrane Liner Parameters

Parameter	Value	Units
sat.hydr.conductivity	2E-13	(cm/sec)
pinhole density	2	(#/ha)
installation defects	2	(#/ha)
placement quality	4	(-)
geotextile transmissivity	0	(cm2/sec)

3.7. Layer. Primary Clay Liner

Top Slope Length: 20.0000
Bottom Slope Length: 55.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Barrier Soil Liner Parameters

Parameter	Value	Units
total porosity	0.427	(vol/vol)
field capacity	0.418	(vol/vol)
wilting point	0.367	(vol/vol)
sat.hydr.conductivity	1E-7	(cm/sec)
Subsurface inflow	0	(mm/year)

3.8. Layer. Secondary LCCS

Top Slope Length: 55.0000
Bottom Slope Length: 55.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Geotextiles and Geonets Parameters

Parameter	Value	Units
total porosity	0.85	(vol/vol)
field capacity	0.01	(vol/vol)
wilting point	0.005	(vol/vol)
sat.hydr.conductivity	1	(cm/sec)
Subsurface inflow	0	(mm/year)

3.9. Layer. Secondary Clay Liner

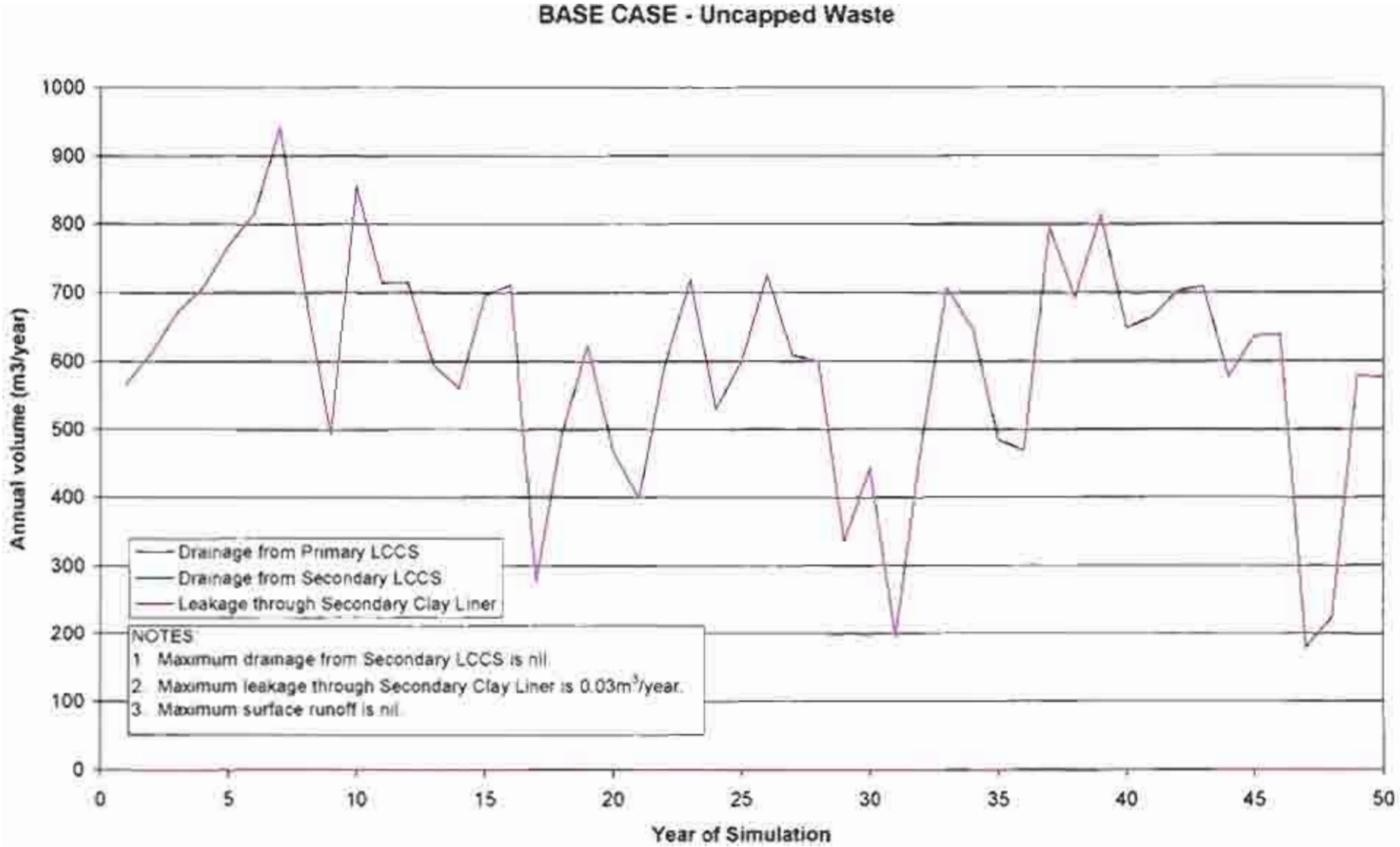
Top Slope Length: 55.0000
Bottom Slope Length: 0.0000
Top Slope: 2.0000
Bottom Slope : 2.0000

[HELP] Barrier Soil Liner Parameters

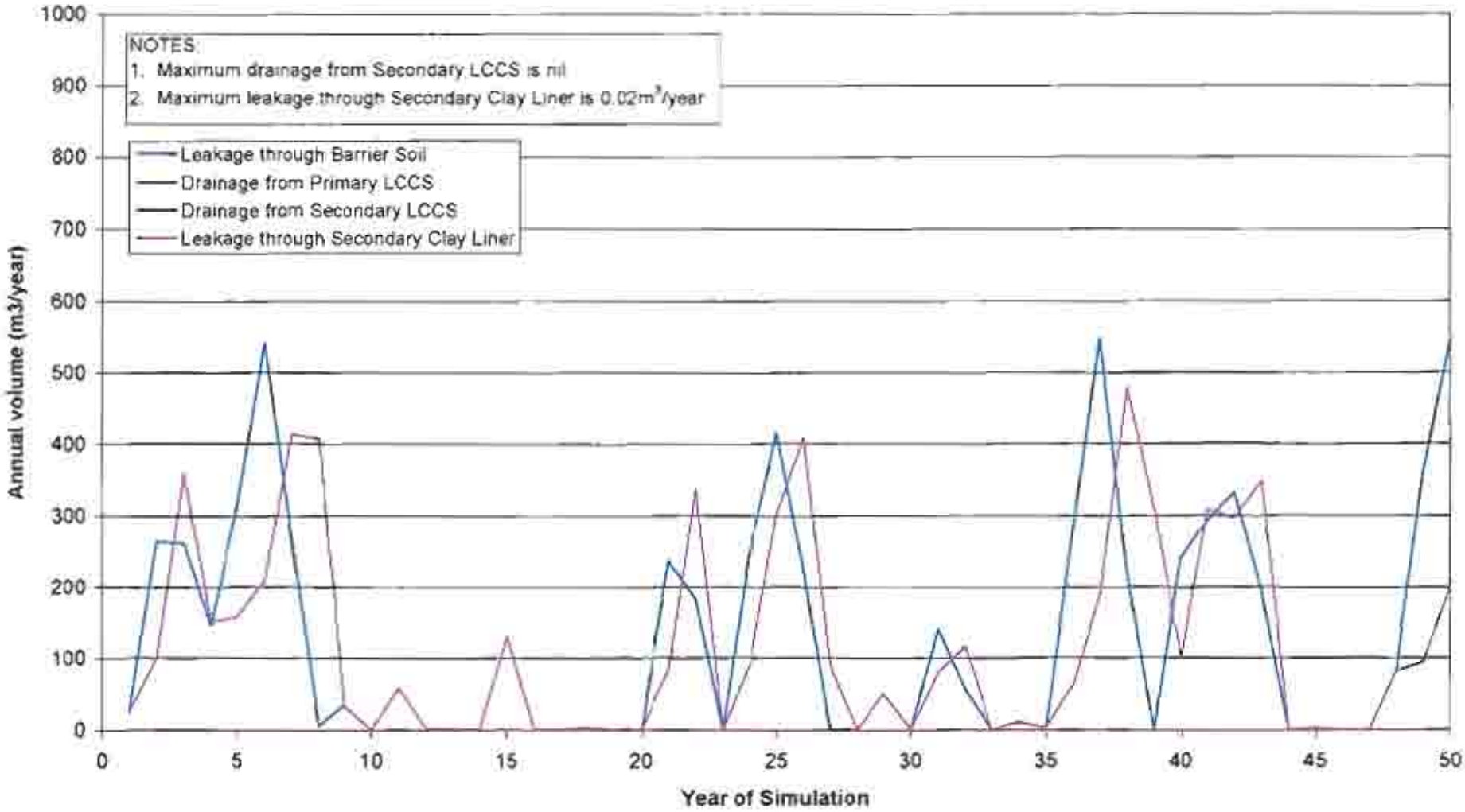
Parameter	Value	Units
total porosity	0.427	(vol/vol)
field capacity	0.418	(vol/vol)
wilting point	0.367	(vol/vol)
sat.hydr.conductivity	1E-7	(cm/sec)
Subsurface inflow	0	(mm/year)

Appendix C

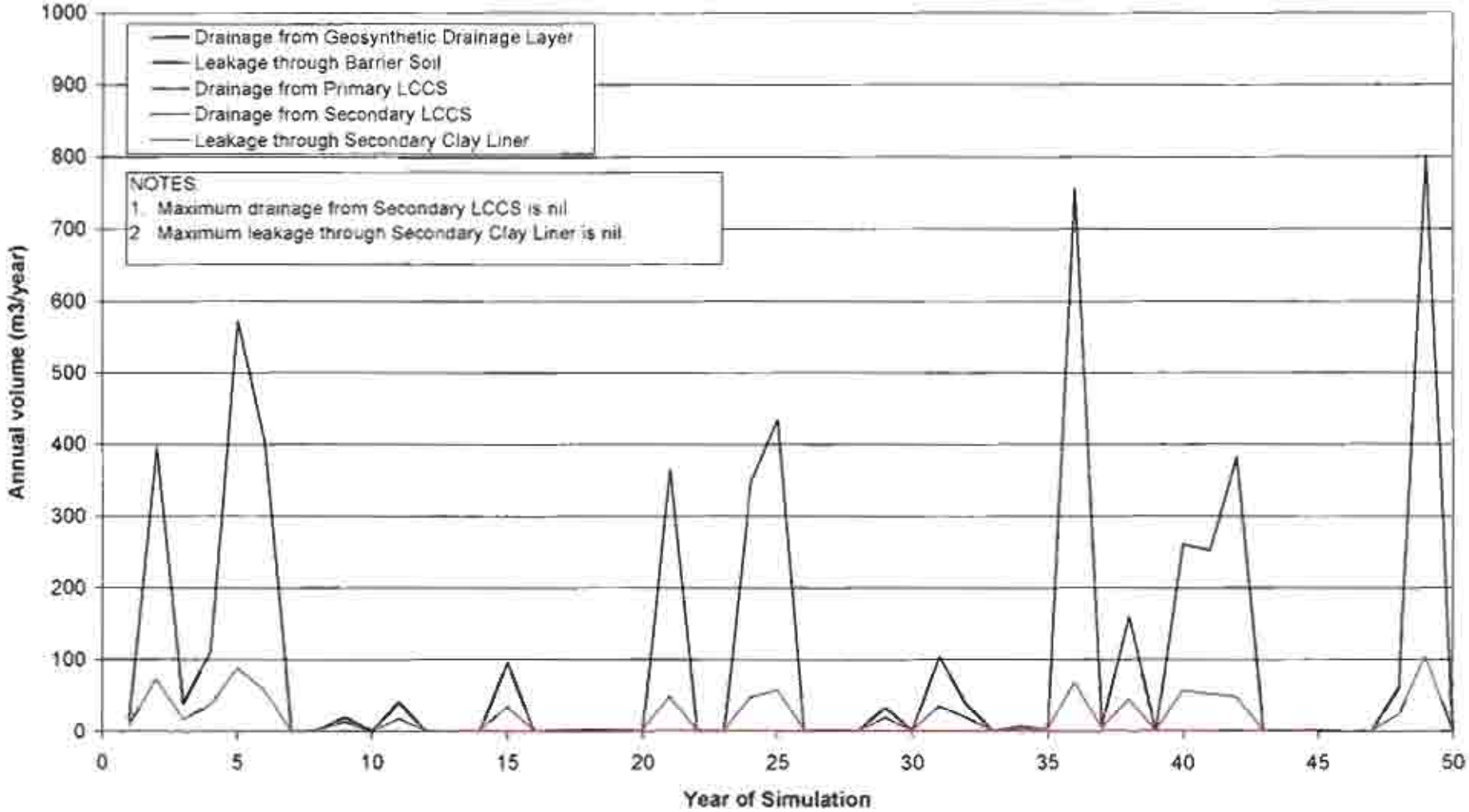
Graphical Water Budget Results – Base Case


BASE CASE - Uncapped Waste
Annual volume (m3/year)
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
40
45
50
Year of Simulation
Drainage from Primary LCCS
Drainage from Secondary LCCS
Leakage through Secondary Clay Liner
NOTES
1 Maximum drainage from Secondary LCCS is nil.
2 Maximum leakage through Secondary Clay Liner is 0.03m³/year.
3 Maximum surface runoff is nil.

BASE CASE - All Layers Except Upper Drainage



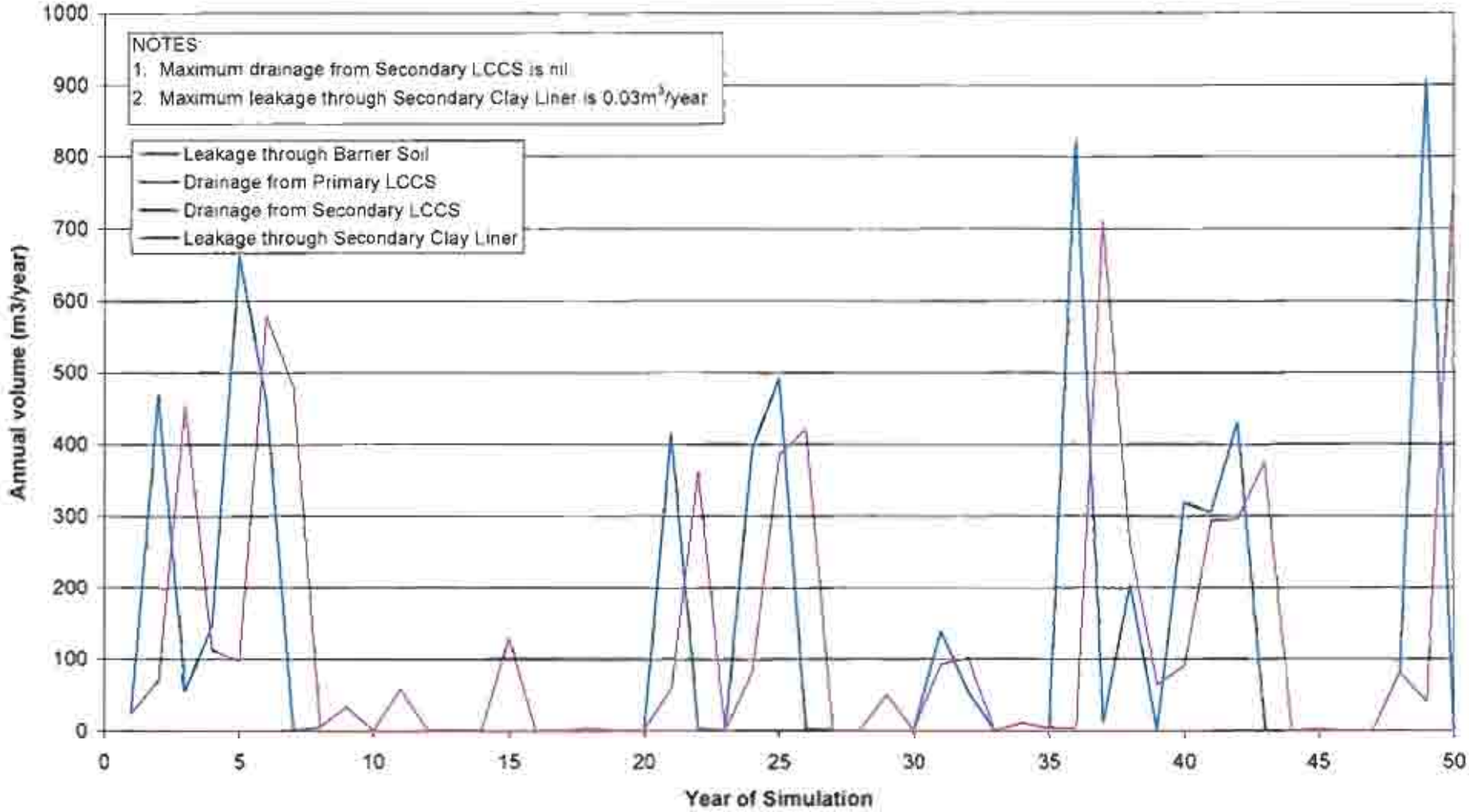
BASE CASE - All Layers



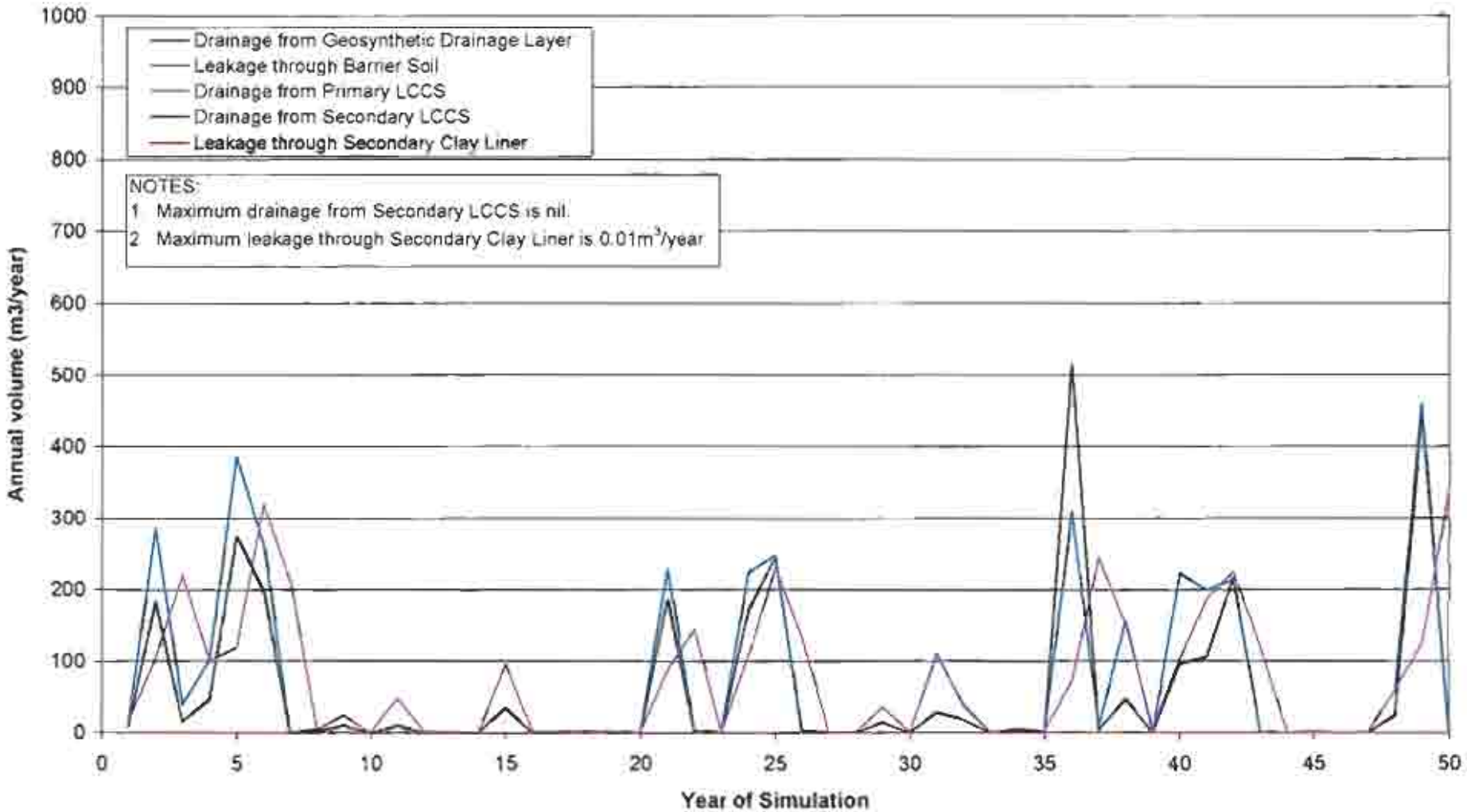
Appendix D

Graphical Water Budget Results – Clay Liner with Higher Hydraulic Conductivity

BARRIER SOIL WITH HIGHER PERMEABILITY - All Layers Except Upper Drainage



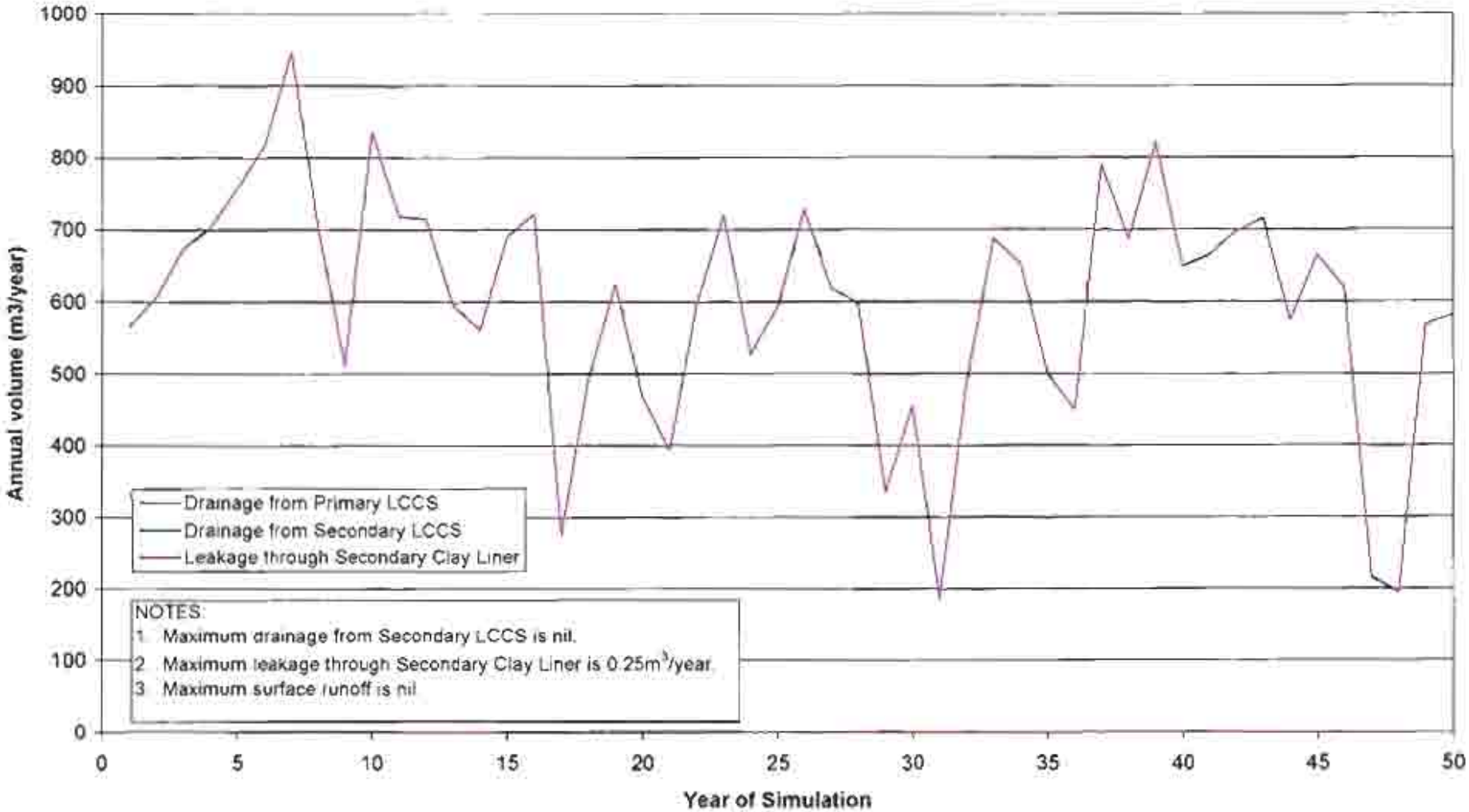
BARRIER SOIL WITH HIGHER PERMEABILITY - All Layers



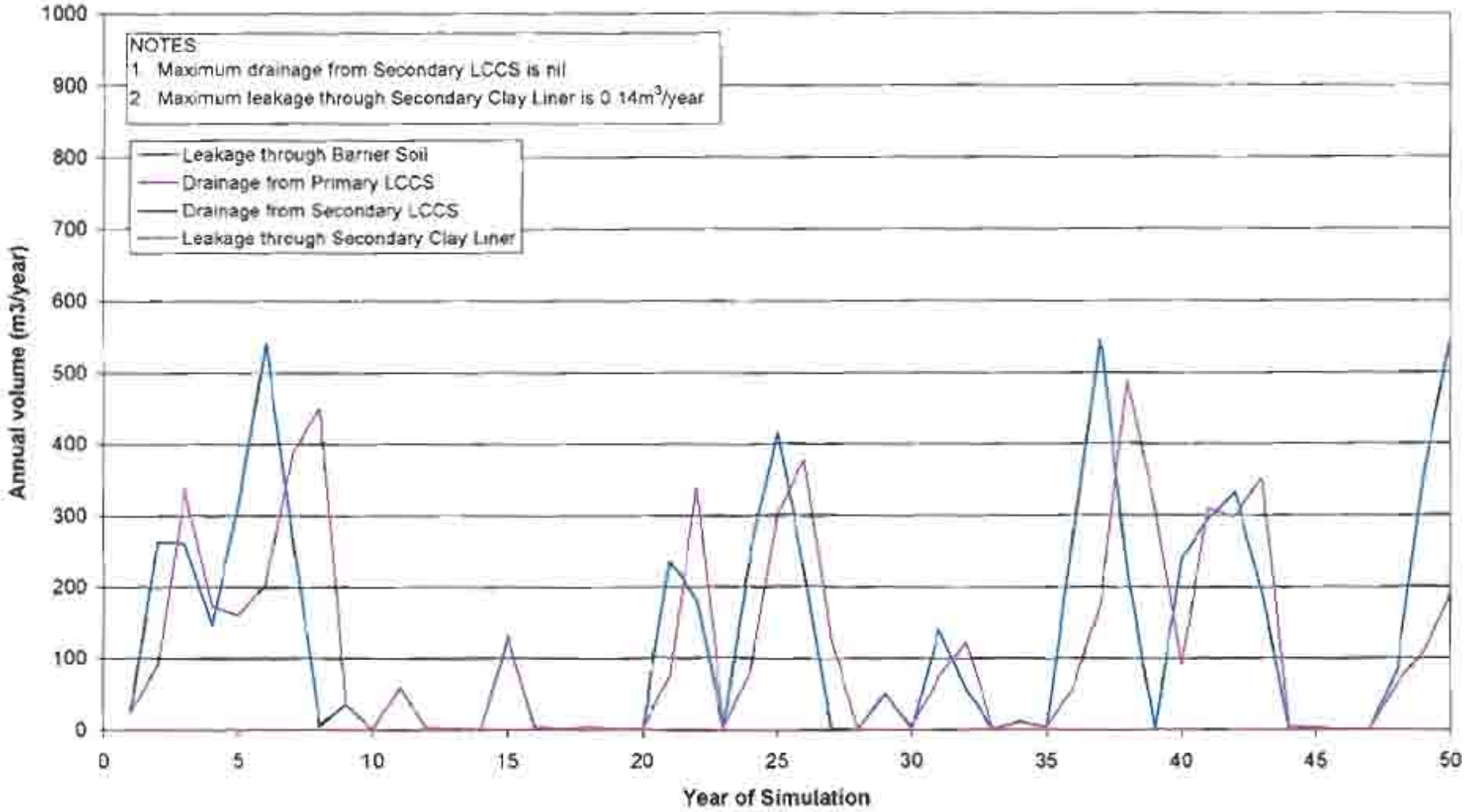
Appendix E

Graphical Water Budget Results – Primary LCCS with Lower Hydraulic Conductivity

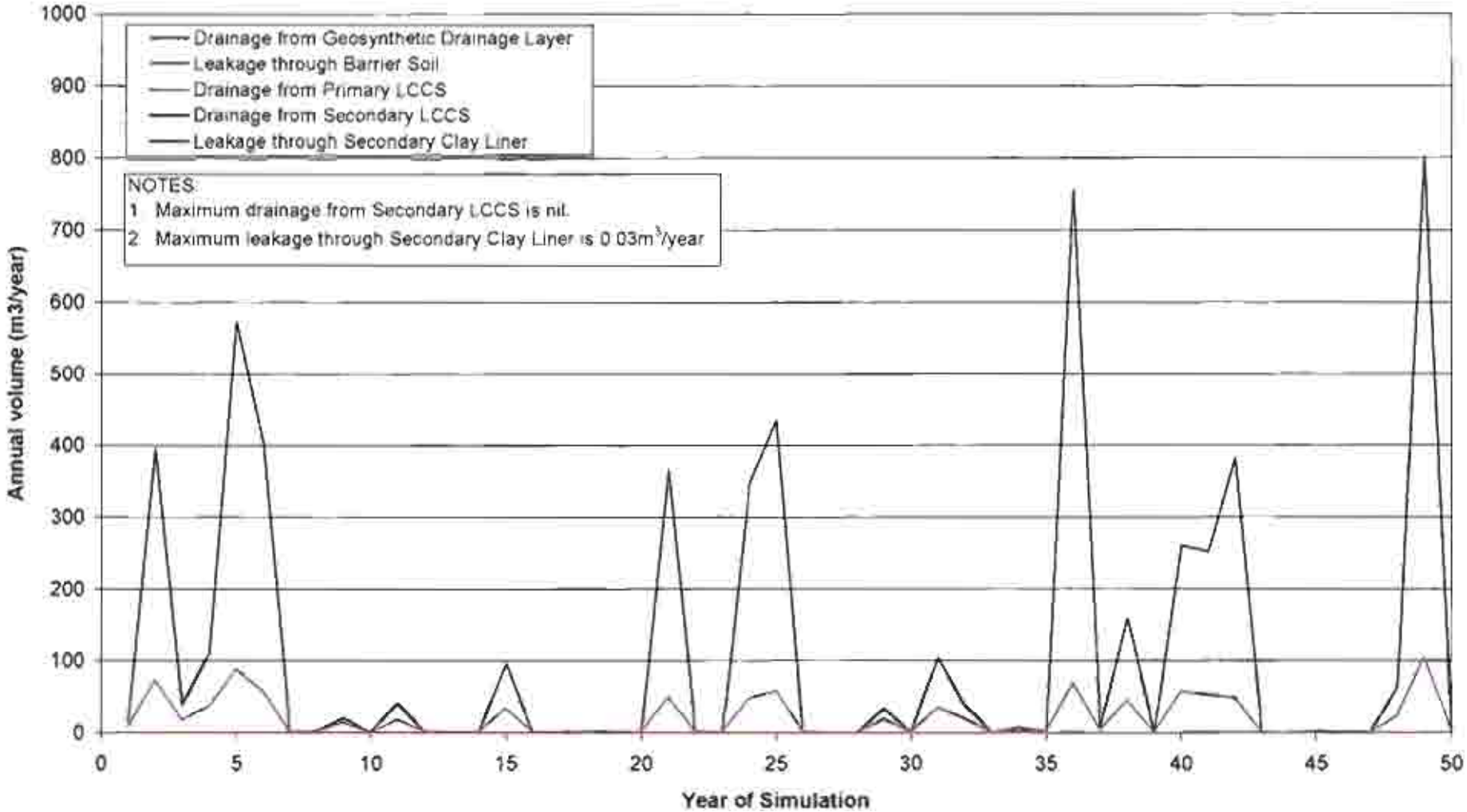
PRIMARY LCCS WITH LOWER PERMEABILITY - Uncapped Waste



PRIMARY LCCS WITH LOWER PERMEABILITY - All Layers Except Upper Drainage



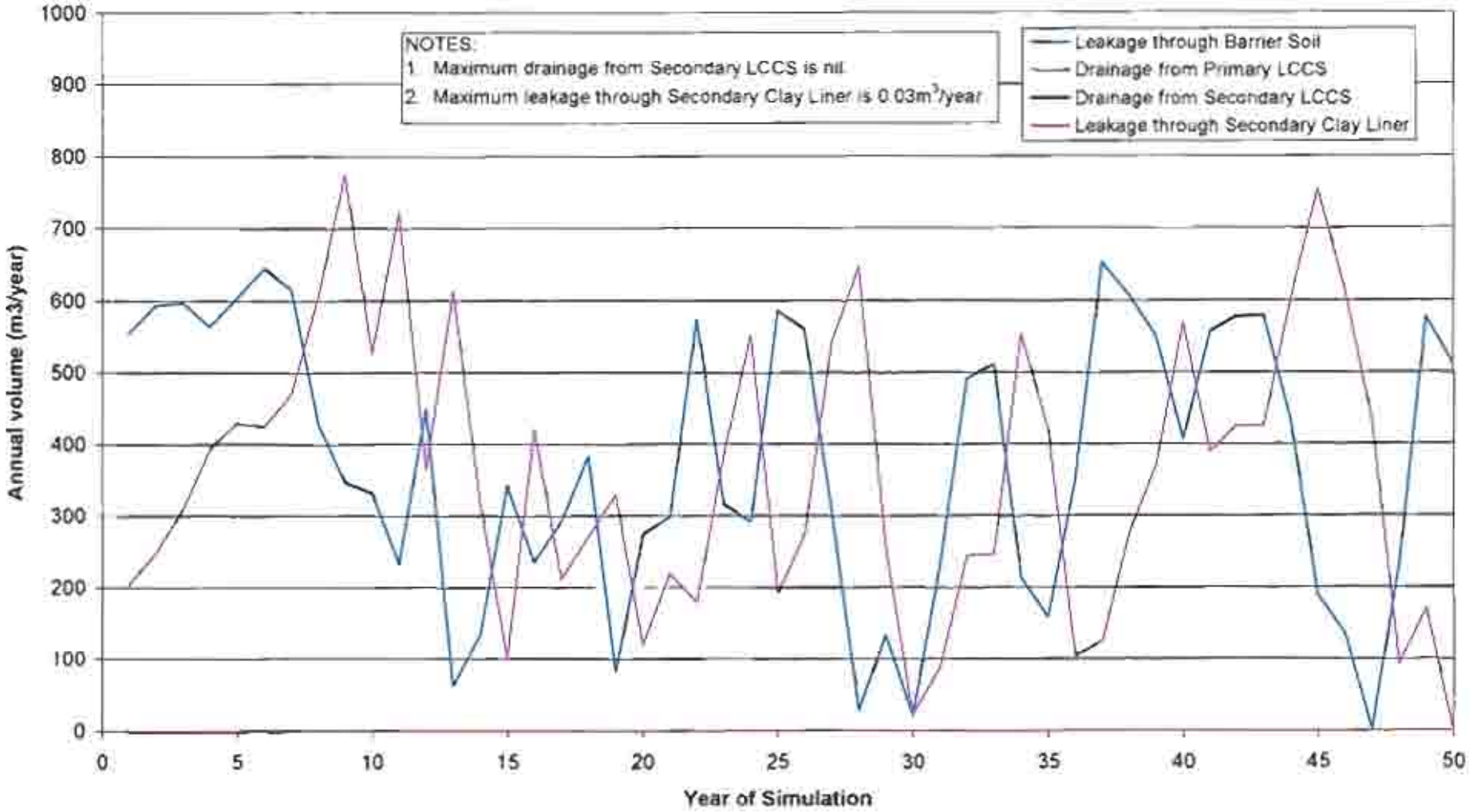
PRIMARY LCCS WITH LOWER PERMEABILITY - All Layers



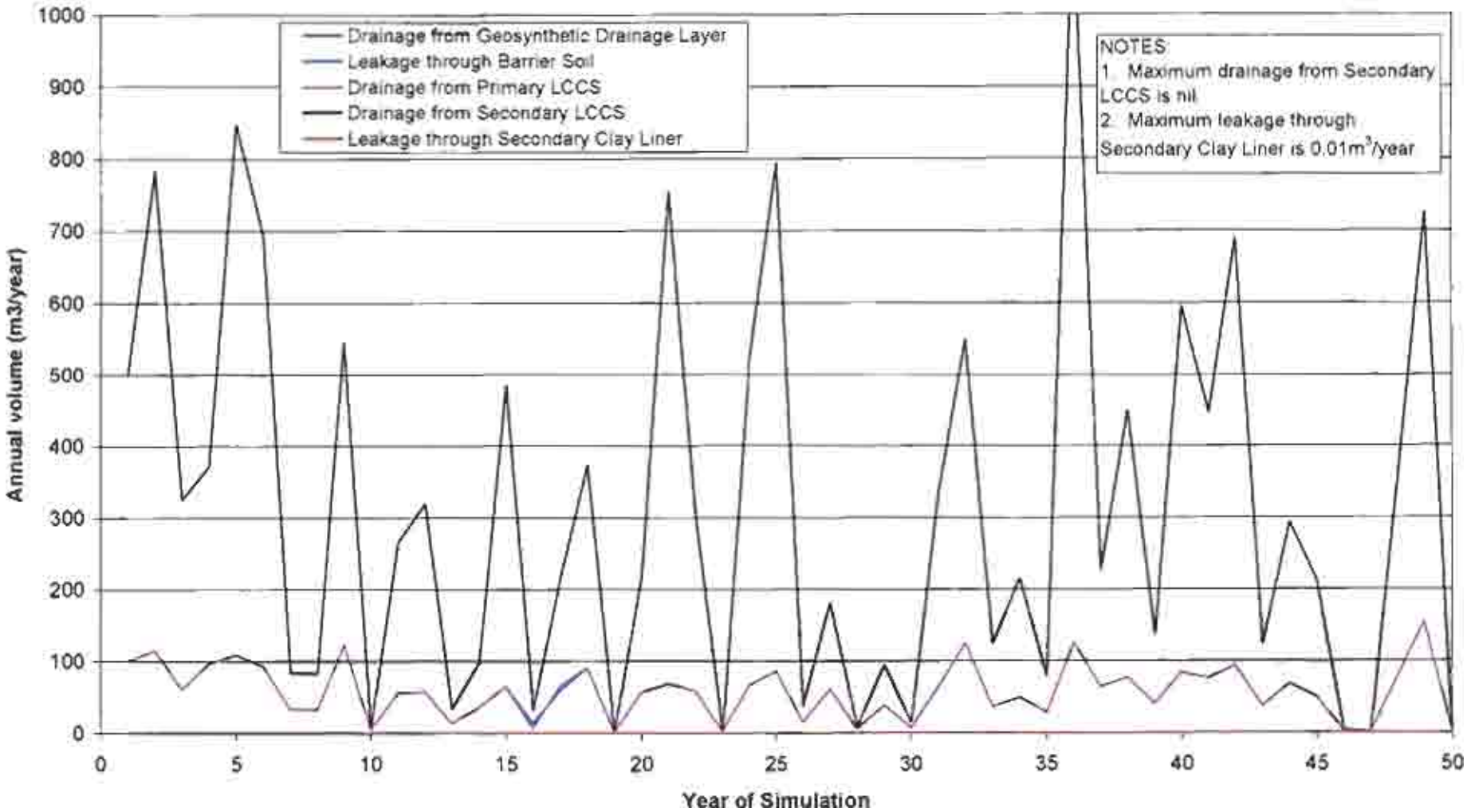
Appendix F

Graphical Water Budget Results – Restoration Soils with a shallow Evaporative Zone Depth

SHALLOW EVAPORATIVE ZONE DEPTH - All Layers Except Upper Drainage



SHALLOW EVAPORATIVE ZONE DEPTH - All Layers



Appendix F

Surface Water Management Plan

7.1 Standards/Codes/Conditions

- Australian Water Quality Guidelines for Fresh and Marine Waters.
- Development Authorisation 29 January 1998, Condition 4, Notes 1, 5, 8 and 9.
- Environment Protection Act, 1993, and Regulations.
- Soil Conservation and Land Care Act, 1989
- Specifications for Surface Water Sampling at South Australian Landfills WMC 1993
- Stormwater Pollution Prevention Codes of Practice (where relevant)
- Water Resources Act 1997 and regulations

7.2 Objectives

- Effectively control surface run-off entering and leaving the site.
- Minimise the amount of contaminated water to be treated as leachate.
- Maintain existing surface water quality.

7.3 Background information

The drainage system consists of three distinct systems:

(a) External Catchments Drainage System
(b) Internal Catchments Drainage System
(c) Waste Contact Water System (leachate collection system)

The final design will involve series of cells that have a ridge through the centre, so that there will not be ponding of water. Capping and vegetation of the finished surface will result in stormwater remaining uncontaminated.

7.4 Internal Catchments Drainage System

The internal catchments drainage system has been designed for a storm with an ARI of 100 years. Run-off that may come into contact with disturbed areas is likely to collect silt. Surface water collection drains will run above the shoulder point of the completed (capped) balefill profile to collection points. From these points, the run-off will be piped down the external slope to the internal site water drain. Corrugated pipe will be utilised to ensure that the pipe will continue to operate effectively in the event of differential settlement of the balefill surface occurring. The run-off will be discharged to the cell perimeter drains, which flow to the sedimentation ponds.

7.5 Management Plan

Sedimentation Ponds	Implemented	To be Implemented
The sedimentation ponds have been designed to capture eroded sediments from cleared areas of completed and capped balefill areas before vegetation is established on these surfaces. Each pond is 2m deep with a length to width ratio of 3:1 as recommended by the CALM method (IEAust [QLD] Erosion and Sediment Control Guidelines, June 1996). The ponds have been designed to accommodate a 1 in 25 year ARI, 24 hour duration storm. The pond locations have been selected so as not to interfere with existing established vegetation.		✔
Under normal operating conditions, water will either be allowed to evaporate or used for dust control purposes. A weir at the end of each sedimentation pond will allow overflow of water back into the external drainage water system in the event of a large storm. As this project is staged, all drains and sedimentation ponds will be built as required, not simultaneously, and discontinued only after rehabilitation of previous stages is completed. The ponds are designed to reduce the water velocity by interrupting the flow and allowing suspended sediment to settle.		✔

External Surface Water Diversion System	Implemented	To be Implemented
Figure 7-1 and accompanying Specifications and Design Plans shows the interim stormwater drainage structures. Surface water control is provided for Stages 1,2 and 3 of the site development by the interim stormwater drainage structures. For location of stages, refer to Balefill Staging Plan Figure 2-1. Further detail of interim drainage during the progressive development of the four low-level cells is given in the accompanying figure.		✔
The Interim external surface water drainage system will use a section of existing large borrow pit as a stormwater containment/evaporation basin (see accompanying figure).		✔
All water from on-site works and currently impinging catchments, will be diverted to these basins. External surface water not affected by the interim works will be allowed to continue across the site as at present.		✔

Internal Drainage System	**Implemented**	**To be Implemented**
For the stages of the development beyond the interim case, sediment contact water drains and sedimentation/evaporation ponds as shown on Figure 7-2 will be progressively developed to ensure that adequate capacity is maintained. It is noted that this system is shown separate from the external surface water drains. Engineering details showing areas of cut and fill (if required) will be provided with the detailed design drawings for EPA endorsement prior to cell construction. Leachate will generally be recirculated back into the current operating cell to enhance the waste stabilisation process. If recirculation into the operating cell is not possible the leachate shall be tested and either exported for treatment or spread on other landfill cells if appropriate.		✔
At the commencement of placing fill into the cell, until completion of the first lift of waste above the leachate collection system, a short-term storage of waste contact water may be required. This would be stored in a pond in the next cell area to be developed until adequate waste is covered for recirculation. Material from the pond base would be incorporated into the excavation for cover for the active cell. Any seepage water would, therefore, be contained within the landfill control system.		✔

On-site Sediment Contact Water Management System -	**Implemented**	**To be Implemented**
Refer to the attached staging plan, SK3. Intercept on-site surface water that has come into contact with disturbed surfaces and stockpiles, (excluding waste) and direct this flow to the sedimentation pond.		✔

Internal Stormwater Diversion System	**Implemented**	**To be Implemented**
Diversion drains and bunding will be used to minimise the volume of potential waste contact water by diverting the water away from the waste.		✔

Maintenance	**Implemented**	**To be Implemented**
Avoid overflow of drains by removing silt to restore the original profile. This will be incorporated into the routine site inspection and maintenance schedule.		✔
Repair any damage to channels that may reduce their functionality.		✔

Maintenance	Implemented	To be Implemented
Long term sediment build up will be collected. Disposal will be into the landfill in accordance with authorisation.		✔
Rebuild bunds as necessary if damage occurs at the landfill face.		✔
Review operational work procedures and adequacy of design.		✔
Construct drainage surfaces and channels to control new or alternate drainage lines.		✔

Monitoring and Corrective Action	Daily	Weekly	Monthly	Annually
Monitor effectiveness of all stormwater installations by visual inspection during and after major flows.	✔			
Replace and improve devices as required to comply with Section 5.3 of the Stormwater Pollution Prevention Code of Practice for the Building and Construction Industry.	✔			
Notify the EPA of any stormwater contamination or in the event of a discharge from a sedimentation pond.	✔			
Assess the effectiveness of the structures by measuring the level of suspended solids on the discharge side during wet weather inspections.	✔			

Appendix G

Liner QA/QC Requirements

Control Procedures for Proposed Lining System

9 November 2003

Integrated Waste Services

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Date: 9 November 2003

Distribution:

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1. Introduction

Parsons Brinckerhoff (PB) was requested by Integrated Waste Services (IWS) to complete further assessment works in relation to the application by IWS to amend the original proposal to include developing a series of contaminated soil cells at the IWS Northern Balefill in Dublin (herein referred to as the site).

As an amendment to the approved Environmental Impact Statement (EIS) for the site, PB prepared a report titled "EIS Amendment: Receipt of Low Level Contaminated Soil & Liquid Treatment Plant Residues at the IWS Northern Balefill", PB report reference 2102250A/002-02-0872-06 dated July 2003. This report detailed the location of, and concept designs for the contaminated soil cells within the individual stages of the site.

Following the submission of the EIS Amendment document, Planning SA provided a response which requested further assessment works and details be provided for the proposed contaminated soil cells.

This report provides recommendations for finalising the construction details of the proposed contaminated soil cell, including the necessary construction quality assurance and quality controls (QA/QC) to be adopted in the cell construction.

2. Lining System QA/QC Requirements

2.1 General

This section outlines the QA/QC requirements for the supply and installation of appropriate geosynthetics to be used in the construction of the Dublin contaminated soil cell. This information is in response to a request from Planning SA to provide additional information on the standard of geosynthetics to be supplied and the likely quality assurance and control methods adopted during the supply and installation stages.

This section includes information on the required material supply standards and the installation quality assurance requirements to be adopted for the geomembrane, geosynthetic drainage composite and geotextile protector respectively.

This section does not include information on the QA/QC requirements for the supply, conditioning and placement of the compacted clay liner.

2.2 Clay Liner Installation

The material used for clay liner shall be from stockpiled material and as identified.

The objective of the placement and compaction work is to achieve low permeability, not high strength. A permeability coefficient of 1×10^{-9} m/sec or lower shall be achieved in the clay liner.

The compaction criteria are:

- Minimum 95% of standard maximum dry density; and
- Moisture content in the range 2% to 4% wet of Optimum Moisture Content.

Note: These may require modification by the Superintendent's geotechnical engineer if necessary to achieve the specified permeability.

The clay liner shall be placed in layers no greater than 200 mm compacted thickness; thinner if found necessary to achieve the permeability results. Vertical joints in clay layers shall be staggered a minimum of 3 m between successive layers.

It is possible that best results will be achieved with a 'sheepsfoot' roller or some equivalent, weighted to ensure that the roller fee penetrate at least ½ height into the layer being compacted; thus kneading the clay rather than rolling over it. Final trimming may be best achieved with a heavy smooth-drum roller.

Any work and the actual liner construction shall be supervised full-time by a Superintendent's suitably experienced geotechnical engineer or senior earthworks technician. Testing shall be rigorous, especially until best practices have been learnt on

site. Level 1 supervision in accordance with AS 3798 and testing will be provided by Superintendent during trails and during clay liner installation.

The top surface of the clay liner shall be trimmed and rolled with a flat-drum roller to provide a smooth free draining surface. Tolerances for finished surfaces are -0, +20 mm above design level.

The Contractor shall keep the surface of the clay liner moist to protect it from drying to below placement moisture content.

2.3 HDPE Geomembrane

2.3.1 Introduction

The geomembrane provides the primary protection to the aquatic environment when placed in direct contact with a compacted clay liner (composite liner).

The geomembrane to be specified for the Dublin contaminated soil cell shall be a premium grade, high density polyethylene (HDPE) manufactured using only virgin polyethylene resins. The geomembrane shall contain a minimum of 97% polymer and a maximum of 3% carbon black. It shall contain no additives, fillers or plasticisers, the only additive is carbon black which provides UV radiation resistance. The manufacture of geomembranes using virgin polyethylene resins will ensure that the virgin polyethylene resins. It is known that virgin polyethylene resins provide the best resistance to chemical attack.

The geomembrane shall have smooth upper and lower surfaces and comply with the specification detailed in Table No 5.1 below. The geomembrane thickness shall be 1.5 mm.

Table 5.1: Geomembrane Properties (Double Smooth)

Typical Properties	Test Method	Nominal Values
▪ Density (g/cc)	ASTM D792	0.94 ϕ 0.92minimum
▪ Thickness (referenced)	ASTM D 5994	1.5mm
▪ Tensile Properties (see notes below)		
▪ Strength at Break (N/mm)	ASTM D638	>20 (see notes 1 & 2 below)
▪ Strength at Yield (N/mm)	ASTM D638	>15 (see notes 1 & 2 below)
▪ Elongation at Break (%)	ASTM D638	150% (see notes 1 & 2 below)
▪ Elongation at Yield (%)	ASTM D638	12-15% (see notes 1 & 2 below)
▪ Tear Resistance	ASTM D1004 Die.C	160-200N
▪ Temperature Brittleness (ºC)	ASTM 0746	- 60 (min)
▪ Puncture Resistance (N)	FTMS 101, Method 2065	> 400 N
▪ Carbon Black Content %	ASTM D1603	2-3%

▪ Carbon Black Dispersion	ASTM D3105	A1/A2
▪ Notched Constant Load Test	ASTM D 5397	400 hours minimum

Typical Properties	Test Method	Nominal Values
▪ Dimensional Stability	ASTM	max. 2%
▪ Melt Flow Index	ASTM D1238	< 1.0g/10min

Notes:

1. The geomembrane shall have strength of greater than 20N/mm at yield and 15N/mm at break.
2. Suppliers may quote environmental stress crack resistance in accordance with ASTM D1693 as a direct comparison to the notched constant load test specified above. A minimum of 1500 hours is required to provide a comparative test result.
3. Manufacturers to supply most recent literature regarding geomembrane lining products prior to approval of tender. This shall include chemical resistance to the key contaminants listed above.

The geomembrane shall have demonstrated chemical resistance to a range of contaminants, and be required to conform to the following:

- Ensure density, notched constant load and resin complies to the requirements of Table 5.1;
- Chemical Resistance to hydrocarbons, solvents and other semi volatile and volatile organic compounds; and
- The names of the proposed geomembrane manufacturer, product name, the independent testing laboratory and the proposed geomembrane liner installer.

2.3.2 Reference Standards and Testing

Reference standards shall comply with the applicable provisions and recommendations of the American Society for Testing Materials (ASTM) except as otherwise shown or specified.

Destructive and non-destructive testing shall be carried out by trained personnel involved in the installation and welding of the geomembrane.

2.3.3 Supply and Delivery

The geomembrane shall be supplied with appropriate packaging identifying the product name, manufacturer and manufacturers date. Roll test data verifying each batch delivered shall be supplied upon arrival to the site. The materials shall not be stacked on site more than four rolls high.

The installer of the membrane shall provide a method statement on how each liner roll will be deployed.

2.3.4 Manufacturers Quality Control

The geomembrane shall be delivered, handled and stored in accordance with the manufacturers recommendations. The following information shall be provided on a consignment sheet for each roll of geomembrane supplied:

- Name of manufacturer;
- Product name and type;

- Thickness;
- Length and width;
- Manufacture date; and
- Each delivery shall be subjected to a visual inspection prior to being allowed into the permanent works lining stocks. For each delivery a quality control certificate shall be provided to ensure that the geomembrane conforms to the properties outlined in Table 5.1 above

2.3.5 Liner Installation

The installer shall have considerable experience of installing geomembranes of the type specified. It will be a requirement for the installer to demonstrate his experience in completing geomembrane installations, including as a minimum:

- Relevant experience of geomembrane installer;
- Typical installation times (m^2/day) for both cell floor and side slopes;
- Information concerning the likely staffing levels for the geomembrane installer;
- Provide the name of a suitable off site laboratory, approved by the Superintendent, that is capable of carrying out the testing required to verify the properties listed in Table 5.1; and
- Provide an accurate drawing showing the proposed panel layout for the geomembrane to a suitable scale.

The geomembrane installation shall follow the following method to ensure compatibility with the existing lining systems and protection of earth filled surfaces:

- The underlying clay layer has been subject to independent quality assurance testing by a suitably qualified geotechnical engineer;
- The clay surface is free of ruts, sharp changes in gradient or large particles within the soil matrix greater than 100mm in size;
- The geomembrane deployment commences on the slopes from the high point of the cell towards the sump and is progressively anchored with soils backfilled at the end of each working shift; and
- The majority of welds shall be fusion (double wedge) unless otherwise geometrical constraints occur. Patches and other areas where fusion welding is not possible, welds shall be extrusion and subject to a satisfactory spark test.

The geomembrane supplier will be required to supply three geomembrane samples to the named geosynthetic laboratory for conformance testing. The parameters listed in Table 5.1 will be tested independently and the results reported to the South Australian EPA.

A drawing showing the proposed panel layout should show the installer's proposed starting point and direction of working, each panel being assigned an individual code. Sloping lining works shall be aligned such that the roll is run out parallel to the slope and

jointing shall be avoided near areas where there are changes in slope gradient (i.e. top and bottom of batters, around sump areas, anchor trenches etc.). It is envisaged that panels will require cutting and shaping around the corners of the cell on the side slopes. Panel diagrams shall show approximate details.

Prior to lining works commencing, the panel diagram shall be submitted for approval by the Superintendent who is independently appointed to check and validate the works.

All surfaces shall be prepared prior to geomembrane installation to the following requirements:

- All surfaces shall be smooth and free of debris and contain no sharp changes in gradient. The geomembrane shall only be placed following approval the clay compaction and testing works; and
- The underlying subgrade shall be final prepared to progress with the rate at which the geomembrane is placed.

No edges between adjacent rolling strips shall be permitted. The geomembrane installer may be instructed to remove areas of lining materials if sharp edges are identified in the underlying subgrade.

2.3.6 Jointing/Welding

The geomembrane shall be jointed into a continuous sheet across the lining works by using double wedge fusion and extruded jointing techniques. The surface welder can be a combination sheet pre-heat and extruder unit or employ a combination dynamic mixing assembly and extruder. **The installer shall provide information on the air pressure he intends to apply to each fusion weld completed. This shall be based on the recommended pressure for a 1.5mm polyethylene sheet.**

The welding equipment shall be capable of continuously monitoring and controlling the temperature in the zone of contact where the machine is actually fusing the lining material so as to ensure that changes to environmental conditions will not adversely affect the integrity of the weld. Only welding equipment which utilises the extrudate fusion process shall be used for extrusion welding the HDPE membrane material.

The width of the surface weld shall be:

- Sheet overlap 100mm minimum;
- Extrudate width 40mm minimum with spark wire; and
- Homogeneous weld zone 25mm minimum.

The installer shall ensure that the prepared surfaces of the membrane do not become contaminated with dust, sand particles, water or any other foreign matter prior to the application of the weld. Where contamination does occur, the prepared surfaces shall be thoroughly cleaned to the satisfaction of the Superintendent and the weld completed. The installer shall be required to purge the barrel of the extrusion welder to remove degraded extrudate.

To prevent differential thermal movement between the upper and lower surfaces of the membrane during the welding operation, the two sections, upper and lower will be held together by tacking using a hot air welding device. Where differential movement is observed the weld in that region will be ground back and a suitable method of repair will be carried out. The repair method will be either by application of extrudate for minor zones or application of a cover piece welded over the problem area.

Following the hot air tacking of the upper and lower layers of sheet, the weld zone shall be suitably abraded by mechanical means immediately prior to the application of extrudate to complete the weld. Suitable care and attention shall be paid to ensure that no overgrind or grind spread occurs.

The wedge weld unit shall be a split head unit. The machine will demonstrate the ability to accommodate all necessary environmental changes without adversely affecting the integrity of the primary weld. Only wedge welding equipment fully approved by the Superintendent shall be employed.

The width of the weld zone shall be:

- Split head unit - sheet overlap 100mm minimum;
- Individual head width 15mm minimum; and
- Homogeneous weld zone 12mm each zone.

The extrudate rod or granule shall be manufactured from the same resin type used in the manufacture of the sheet and all physical properties shall be the same as those possessed by the sheet raw materials. The manufacturer shall provide certified test data with each and every roll of extrudate rod or granule to certify this requirement.

Where extrudate granule is supplied it shall be packaged in a manner that will not allow the ingress of moisture and other contamination. Each bag of extrudate granules shall be tested for moisture content and where contamination has occurred the manufacturer shall be responsible for drying or replacing same.

Where extremes in temperature and humidity and/or rainfall are encountered, the installer shall ensure that all granule or extrudate rod are kept in a suitable storage area that will not attract moisture, or in the event that operations are being undertaken in the field that suitable moisture extraction methods shall be applied to the granule and/or rod such that extrudate contamination does not occur. Any evidence of uncontrolled moisture content in the form of the final extrudate beads shall be grounds for rejection.

2.3.7 Field Trials

All jointing methods adopted shall be subjected to field trials. Trial seams shall be carried out daily for routine inspection by the Superintendent prior to lining works commencing for each lining machine in operation. This frequency shall change following a change in operator, machine or a period of machine shutdown.

Field trial seams shall be approximately 2m long for extrusion welds and in the case of fusion seams jointing shall be 3m long. The installer shall be required to cut a total of four 25mm wide field tabs normal to both types of seam to form a sample. Three of the samples shall be subjected to a destructive peel test and one sample subjected to a

uniaxial tensile test. The seam will be deemed to have passed destructive testing if the failure occurs solely in the parent material and does not occur on any part of the joined surface.

2.3.8 Field Seams

The installer shall ensure that all field seaming complies with the following:

- Pre-treatment of contact surfaces by grinding and cleaning;
- Maintain extrudate and or wedge temperatures to manufacturers recommendations;
- Seaming not allowed during inclement weather unless correct precautions are taken to ensure that all seaming surfaces are dry;
- Seaming around saturated strata is not permitted; and
- Maintain ambient temperature above 5ºC for all seaming works.

The installer shall provide information concerning the geomembrane manufacturers recommended minimum overlap width prior to commencing geomembrane installation. This overlap shall be measured regularly and marked on the surfaces of the jointing geomembranes. Should this overlap distance differ from that which is specified above, the installer shall notify the Superintendent prior to deployment of the geomembrane.

2.3.9 Geomembrane Sampling and Testing

All field seams will be subjected to both non-destructive and destructive field testing during the welding of the geomembrane. If required, representative samples will be sent to an off site geosynthetic laboratory. The following tests will be carried out at the required frequencies.

2.3.9.1 Non-Destructive Testing

- For extrusion joints using compatible polymer beads, the non-destructive test shall be the high voltage spark test. The test involves encapsulating a conductive wire within the weld. A spark test will identify whether there is an imperfection in the weld.
- For Double wedge seam joints, the two welds shall be independent of each other for this non-destructive test to be successful. The air channel shall be pressurised to the manufacturers recommended pressure. Following initial pressure stabilisation the pressure drop along the joint length shall not be greater than 10% in 10 minutes.

2.3.9.2 Destructive Testing

The installer shall cut a field tab 25mm wide from the beginning and end of each completed double wedge fusion seam and it shall be subject to one number peel test and one number uniaxial tensile test. The Installer shall ensure that an insitu field **tensometer** be provided by the Installer for all destructive testing. Should an extensometer not be provided, additional field tabs shall be sampled and sent to an independent test laboratory.

Where joints fail destructive testing the installer shall identify the failed area and carry out repairs in accordance with Section 4.8 of this Specification. Further non-destructive testing will be carried out to ensure the repairs are completed to the satisfaction of the Superintendent.

A joint shall then be passed when destructive testing is successful (i.e. failure of sample strip away from weld). Seam reconstruction will be necessary if both the peel test and tensile test are unsuccessful. Further sampling may be required at the discretion of the Superintendent.

2.3.10 Independent QA Testing

2.3.10.1 Weld Testing

During the fabrication of the geomembrane seams, selective destructive samples shall be taken during the destructive testing stage from passed joints. A further 3 tabs shall be taken every 300m of fabricated seam for quantitative results and the mode of failure for the tests carried out. The third sample tab shall be retained by the Superintendent on site for archiving. The independent quality assurance testing will aim to verify that the weld strengths reaches the required strengths for peel and direct tension in accordance with the requirements below.

The seam strengths shall conform to the following:

- The strength of the seam in shear shall be 70-90% of the sheet strength;
- Seam strength in peel shall be 50-70% of the sheet strength; and
- The seam will be deemed to have passed quantitative destructive testing if the strength requirements in (i) and (ii) are met and/or the specimen failure occurs solely in the parent material and does not enter the seam. The cost for independent QA testing shall be borne by the Principal.

The locations of all tabs taken for quantitative destructive testing shall be recorded relative to the panel drawing issued as part of the requirements of Section 4.5. Repair patches shall be extruded over the areas where samples have been tested and shall be subjected to the high voltage spark test.

2.3.10.2 Geomembrane Sheet Properties

In order to verify the geomembrane sheet properties, a total of **three** 1m wide samples cut from five separate rolls across the roll width shall be removed and retained by the Superintendent. The following properties shall be tested at the Superintendents expense:

- Thickness;
- Density;
- Tensile Properties (break and yield);
- Carbon Black Dispersion;
- Carbon black Content; and

- Notched constant load test.

The majority of samples shall be recovered from the first consignments of geomembrane delivered to site. Sampling shall be completed from both types of geomembrane.

2.3.11 Geomembrane Repairs

All discontinuities in the geomembrane liner (due to test failure, damage or sampling procedures) shall be repaired by the Installer to the following requirements.

Damage Defects

The area shall be prepared in accordance with the above and an extra layer of extrudate applied.

For large damage faults (e.g. caused by plant) the area of liner shall be cut back to remove all imperfections and shall be overlain with a single piece of geomembrane to give a minimum overlap of 100mm in all directions.

Seam Defects

Faulted extrusion joints shall be overlain with a single piece of geomembrane with a minimum overlap of 100mm in all directions.

Faulted double wedge seam joints shall be cut back to remove the upper flap, prepared in accordance with the above and extruded with a patch or similar approved repair method.

2.4 Geotextile Protection Layer

2.4.1 General

The function of the geotextile protection layer will be to protect the 1.5mm HDPE geomembrane from mechanical damage by the overlying cover soils, leachate collection blanket and waste during construction and for the life of the landfill. The geotextile will therefore require the weight, CBR puncture protection and thickness to be specified to ensure the strains imposed on the geomembrane limit any defects being built up over time. In addition, the chemical resistance of the geotextile fibres which make up the geotextile requires consideration. The geotextile protector is particularly important during the installation of the drainage gravel.

In this regard the geotextile protection layer will prevent abrasion and puncture of the HDPE liner thereby preserving the integrity of the liner for the purpose of preventing leachate and waste liquid components leaking from the contaminated soil cell and subsequently entering and polluting the water resources in the local area. Stringent quality assurance standards shall be maintained throughout the contract to ensure the integrity of the liner. This is particularly relevant during the installation of the protection geotextile, and strict QA/QC procedures shall be adopted to ensure the geomembrane is free from defects and the surface free of debris prior to the deployment of the geotextile protector.

2.5 Reference Standards and Testing

Reference standards shall comply with the applicable provisions and recommendations of the American Society for Testing Materials (ASTM) except as otherwise shown or specified.

2.6 Geotextile Protection Layer Material Specification

2.6.1 General

The geotextile shall comprise a non-woven staple fibre needlepunched polypropylene cushion, to comply with the general requirements of Table 5.2. The geotextile shall be UV stabilised and by needle free manufactured under a quality system conforming to the requirements of AS 3902-87 for use as a protective cushion adjacent to impervious liners. The geotextile shall have a minimum CBR puncture resistance of 4500N and minimum mass of 500g/m^2.

Materials and physical properties shall comply with Table 5.2 below.

Table 5.2: Material and Physical Properties of Needlepunched Geotextile Protection Cloth

Property	Test Method	Specification	Units
Material		Staple fibre needlepunched polypropylene	
Minimum Mass	AS 3706.1	500	g/m^2
Thickness (minimum)	AS 3706.1	5	Mm
CBR	AS 3706.4	4500	N

2.6.2 Manufacturer's Quality Assurance Report

Each roll shall be issued with a Manufacturer's Quality Assurance Report.

No materials will be accepted for delivery to Site or progress payment made unless all necessary manufacturers' quality assurance certification data has been provided to the Superintendent. All such data must be supplied in sufficient time such that no delay shall be caused to the program. Failure to provide the requested data and any resultant delay will not be grounds for an extension of time or removal of any commercial penalties that accompany this Contract.

Manufacturer's Quality Assurance Report

The Report shall be prepared for each and every batch and shall conform to the values specified in Table 5.2 above.

Separate reports must be provided for each roll and issued at the same time the material is manufactured or within 14 days of sampling. The report must be presented prior to the arrival of each roll to the Site.

Each roll shall be so labelled as to provide the following identifying data:

- Roll No;
- Batch No. of raw material;
- Date of Manufacture;
- Material Thickness;
- Roll Length and width; and
- Reference to quality assurance report.

Independent Laboratory Testing

The installer shall deliver all materials to Site following the provision of the specified quality assurance certificates.

The Superintendent reserves the right to undertake separate, independent laboratory analysis that will qualify the manufacturer's test reports. Any deviations from the manufacturer's reports or the statements contained within the installer's proposal, will be grounds for rejection.

Where deviations from the test report supplied by the Manufacturer, copies of the independent test reports shall be provided to the manufacturer's representative for evaluation. Where, in the opinion of the independent testing authority, the materials do not comply with the intent of this Specification, the materials will be removed from Site by the manufacturer and replaced with new conforming materials. All subsequent independent tests shall be undertaken at an approved testing authority experienced in the testing and evaluation of geosynthetic materials. This shall be approved by the Superintendent appointed to independently verify the lining works.

2.7 Geotextile Protection Layer Installation

The Geotextile Protection Layer shall be placed in a continuous length down the slope and shall be lapped over adjacent Geotextile Protection Layer sheets by a minimum of 500mm. The cloth shall be installed using methods that will not damage the material upon which it is lain. The entire surface of the geotextile shall be inspected during unrolling and placement to ensure that there are no tears, abrasions or other faults in the material. For the eastern slope, the reinforced woven surface shall be placed upwards.

In particular any imperfections and faults identified within the Manufacturer's Quality Assurance Reports will be referenced and repaired. Where additional faults are observed by the Superintendent, that have not been identified within the Manufacturer's test report the Superintendent reserves the right to totally reject that roll and have it replaced by the installer. The installer shall be responsible for all costs associated with the supply, delivery and testing of all replacement materials. Where such action causes

a delay in the Works, if applicable, the installer shall be responsible for the payment of all liquidated damages.

The installer shall ensure the geotextile to be deployed down the slopes is temporarily anchored prior to rolling down the slope.

The superintendent recommends the GCL and geomembrane be anchored and the tench backfilled along the eastern slopes prior to the geotextile anchor trench being excavated. This will prevent any problems with maintaining an open anchor trench upon which to deploy the geotextile protector into.

2.8 Geotextile Quality Assurance

All approved geotextiles shall be manufactured from prime virgin fibres manufactured from the same polymer resin. Recycled fibres shall not be permitted for any geotextile used in this project. The fibres shall contain a minimum of 1% by weight of active carbon black, except if polyester continuous monofilament geotextiles are deployed on the northern side slope. The woven component of the reinforced geotextile for the eastern slopes shall be manufactured from polypropylene. Alternative materials and combination of materials can be proposed provided suitable UV protection and the tensile strength requirements for the composite are met.

Geotextiles shall be delivered to site clearly labelled and shall include a manufacturers batch reference number.

Every roll delivered to site shall have a delivery ticket included within the packaging. The certificates shall include the following details:

- Batching reference number;
- Date of Manufacture;
- Product name and type; and
- Unit weight (g/m^2).

The installer / supplier shall provide technical information on all approved geotextiles which shall include the following:

- Minimum CBR puncture resistance; and
- Minimum thickness under 2kPa load.

2.9 Quality Assurance Testing

All approved geotextiles across the base and side slopes shall undergo quality assurance testing at the following frequencies:

- Weight every $3000m^2$ (g/m^2);
- Thickness every $3000m^2$ (mm); and

- CBR puncture resistance every 3000m^2 (N).

Sufficient geotextile samples shall be recovered at the above frequencies from the permanent lining works. For CBR puncture resistance, the average of 3 CBR puncture resistance tests shall be taken to assess the performance of each geotextile. Geeotextiles samples shall be recovered and sent to an independent geosynthetics laboratory approved by the Engineer.

2.10 Leakage Detection System

2.10.1 Introduction

The leakage detection system shall be a geocomposite drainage system comprising a high transmissivity permeable HDPE core sandwiched between two separator geotextiles heat bonded to the upper and lower surfaces as detailed in the drawings. The separator geotextiles shall prevent the underlying and overlying clay layers from impeding in the overall performance of the composite product.

The geocomposite leakage detection system, as approved by the USEPA for use in hazardous waste containment facilities, outperforms traditional granular blankets in the following ways:

- The geocomposite drain provides an unyielding surface, which is stable enough to enable mineral lining systems to be constructed above them;
- The migration of fines into the core of the product is prevented by inclusion of a separator geotextile thermally heat bonded to the core; and
- The core is manufactured from HDPE, which provides a long term chemical resistance to aggressive chemicals.

2.10.2 Geocomposite Drainage Properties

Several geocomposite drainage products have been assessed based on a technical equivalency to ensure equivalent transmissivities when compared to drainage stone products. The long term integrity and function of the drainage system is maintained by the provision of separator geotextiles, which are nominally heat bonded to the core product on both lower and upper surfaces. This prevents the migration of fine grained soils into the core, which primary function is to transmit leakage to a central leakage detection collection sump.

The geocomposite drainage system shall be a drainage net core manufactured from HDPE (e.g. geogrid, Enkadrain 8004, polyfelt DNC 3514-2, Tenax TNT 450, Terram 1B1, terrafix TN1 or similar approved). If a drainage composite manufactured and supplied with geotextiles is used an individual separator geotextile will not be required. The installer / supplier shall provide the following technical data concerning the underdrainage system.

- Hydraulic transmissivity at hydraulic gradients of 0.02, which represents the fall of the contaminated soil cell;

- Demonstrated transmissivity performance at surcharges of 200kPa. A typical transmissivity of $0.5mx10^{-4}$ m^2/s is required to provide demonstrated leakage performance based on the approximate surcharges imposed on the base lining system following completion of waste disposal;
- Hydraulic performance of composite product with increasing normal stress; and
- The properties of the geotextile separator. The geotextile properties shall be in accordance with Table 5.3 below.

Table 5.3: Geocomposite Drainage Properties

Property	Minimum Value
Composite Drain	Transmissivity of $0.5mx10^{-4}$ m^2/s at a surcharge of 200kPa
Geotextile	Mass $190g/m^2$, continuous monofilament heat bonded to upper and lower surfaces or a $140g/m^2$ needlepunched product.
	Effective opening size (O_{90}) of 0.1mm
Jointing	Overlap in accordance with manufacturers recommendations or cable tied together.
Roll width	2m, 3.6m, 4m (depending on manufacturer)

The geocomposite drainage system shall cover the entire area of the compacted clay across the base and side slopes of the cell as shown in the drawings.

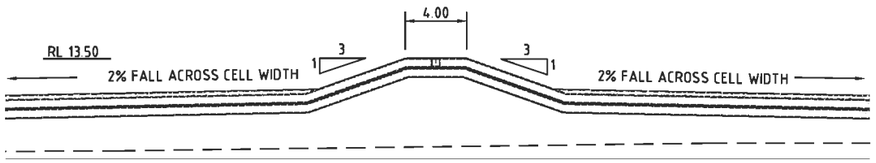
2.11 Alternative Geocomposite Product

Depending on the availability of manufactured geocomposite drains, the supplier may consider the use of an alternative drainage composite comprising the following:

- A HDPE core with a minimum transmissivity of $1x10^{-3}m^2/s$ under a 2kPa surcharge;
- Two separator geotextiles placed above and below the core. The separator geotextiles shall have a mass of $180g/m^2$, and be heat pressed and manufactured from continuous monofilament polyester or polypropylene fibres. Geotextiles manufactured from recycled fibres shall not be permitted for the cell A3 lining works; and
- The supplier shall demonstrate the composite transmissivity of the product in accordance with Table 5.3 above.

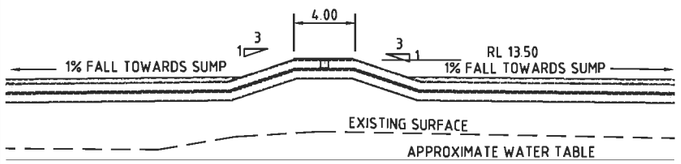
Appendix H

Revised Cell Design Drawings



SECTION 2 / SCALE 1:200

LINER DETAIL AT JUNCTION OF TWO CELLS



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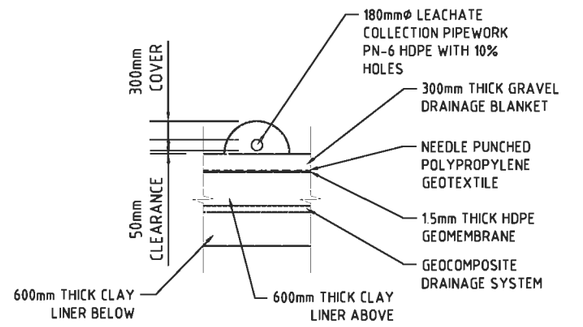
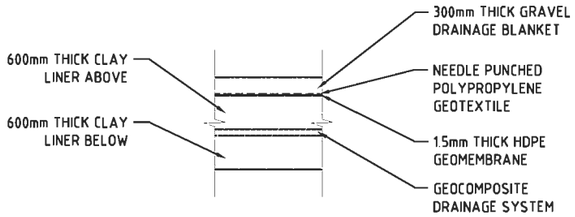
LINER DETAIL AT JUNCTION OF TWO CELLS



SECTION THROUGH LEACHATE COLLECTION SPINE DRAIN

SCALE 1:50



TYPICAL SECTION THROUGH LINER

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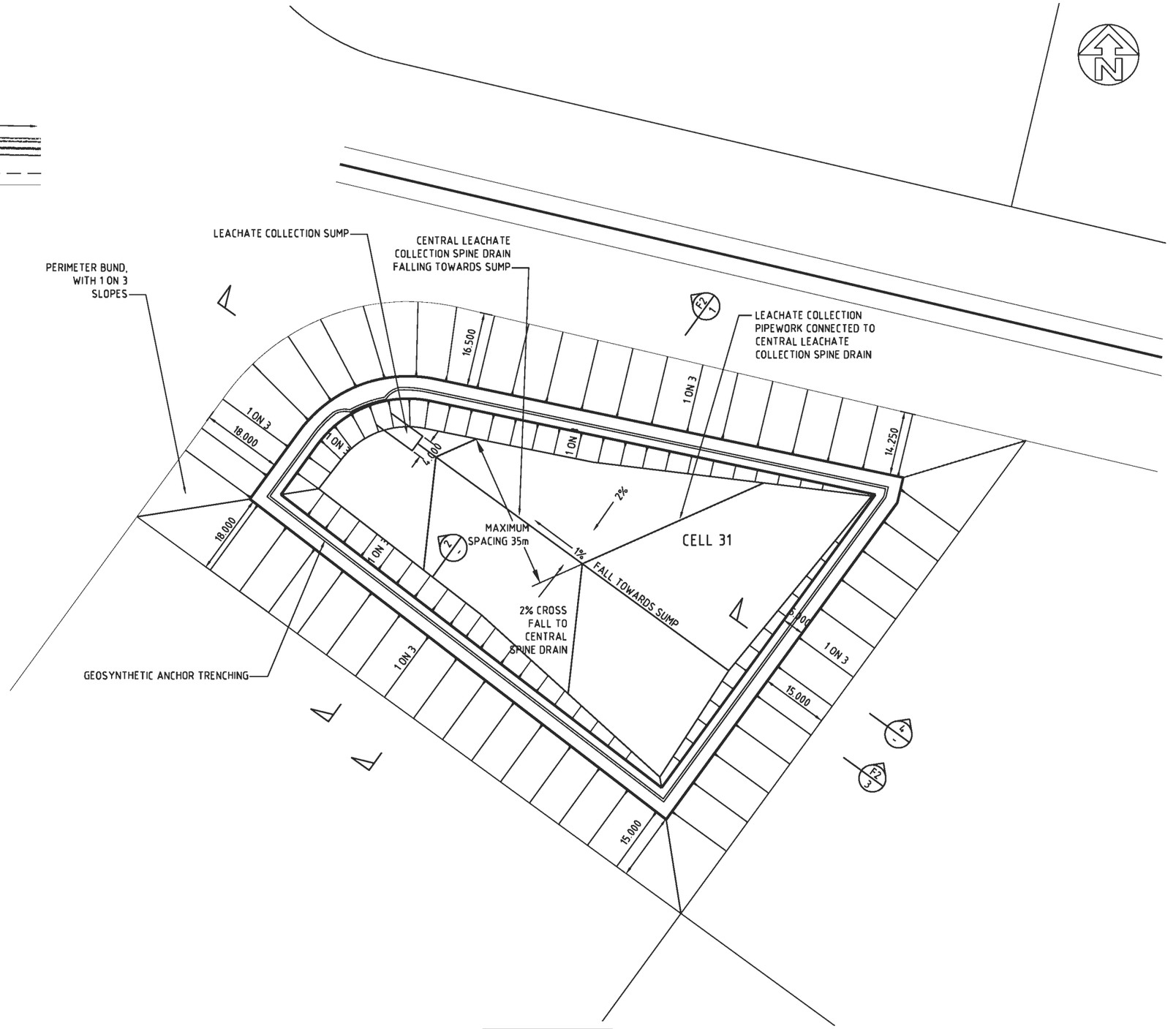
STEED & POHL SURVEY REFERENCE 6693-C#25#26#30 DATUM AMG



P:\A303\2102201-2102300\2102250\DRAFTING\2102250C\DRAWINGS\FIG 01.dwg, 30/04/2004 2:41:09 PM, Adobe PDF.pc3, 1:2

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		Date
Drawn	KM	03/04
Designed	MDL	03/04
Drawing Check	MDL	03/04
Design Check	MKD	03/04
Project Approval		03/04

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Client: INTEGRATED WASTE SERVICES

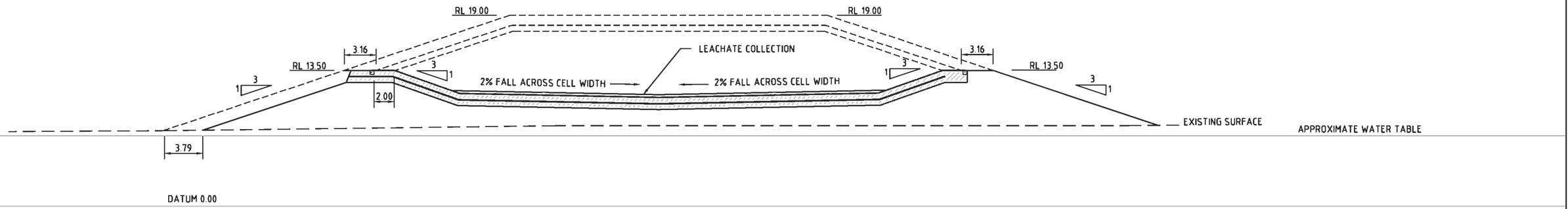
Project: I.W.S.
LOW LEVEL CONTAMINATED SOIL
CONCEPT DESIGN
PLAN AND DETAILS

Job No: 2102250C

Drawing No: FIGURE 01

Sheet No.: 1

Rev:



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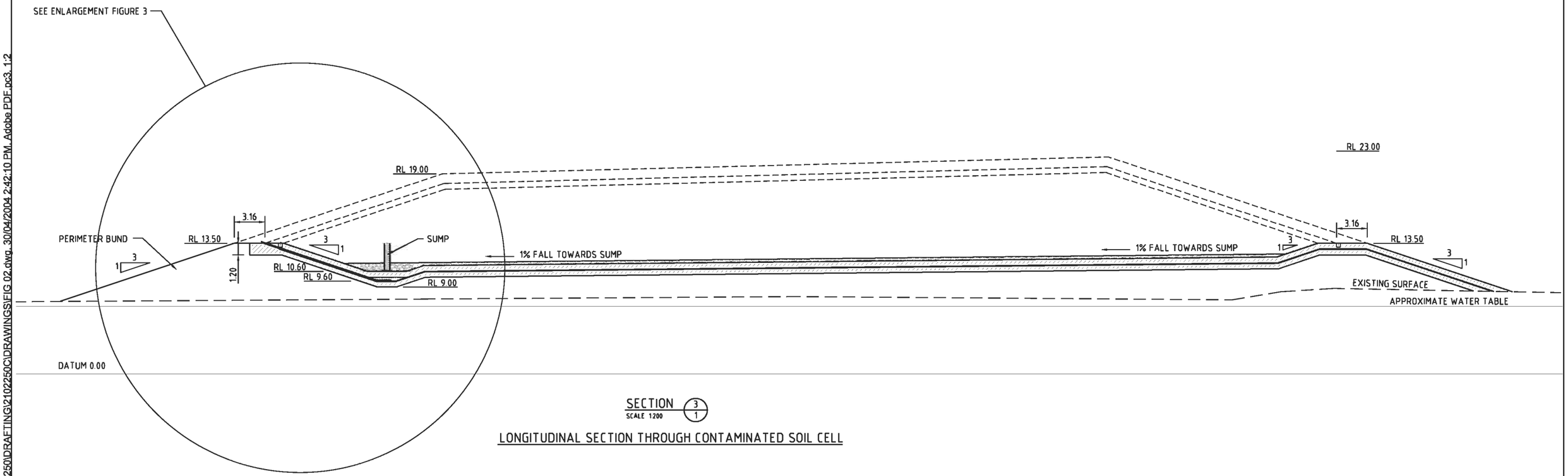
LONGITUDINAL SECTION THROUGH CONTAMINATED SOIL CELL



SECTION 3/1
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LONGITUDINAL SECTION THROUGH CONTAMINATED SOIL CELL

P:\A303\2102201-2102300\2102250\DRAFTING\2102250C\DRAWINGS\FIG 02.dwg, 30/04/2004 2:42:10 PM, Adobe PDF.pc3, 1:2

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Drawn	JM	Date 03/04
Designed	MDL	Date 03/04
Drawing Check	MDL	Date 03/04
Design Check		Date 03/04
Project Approval		Date 03/04

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Client: INTEGRATED WASTE SERVICES

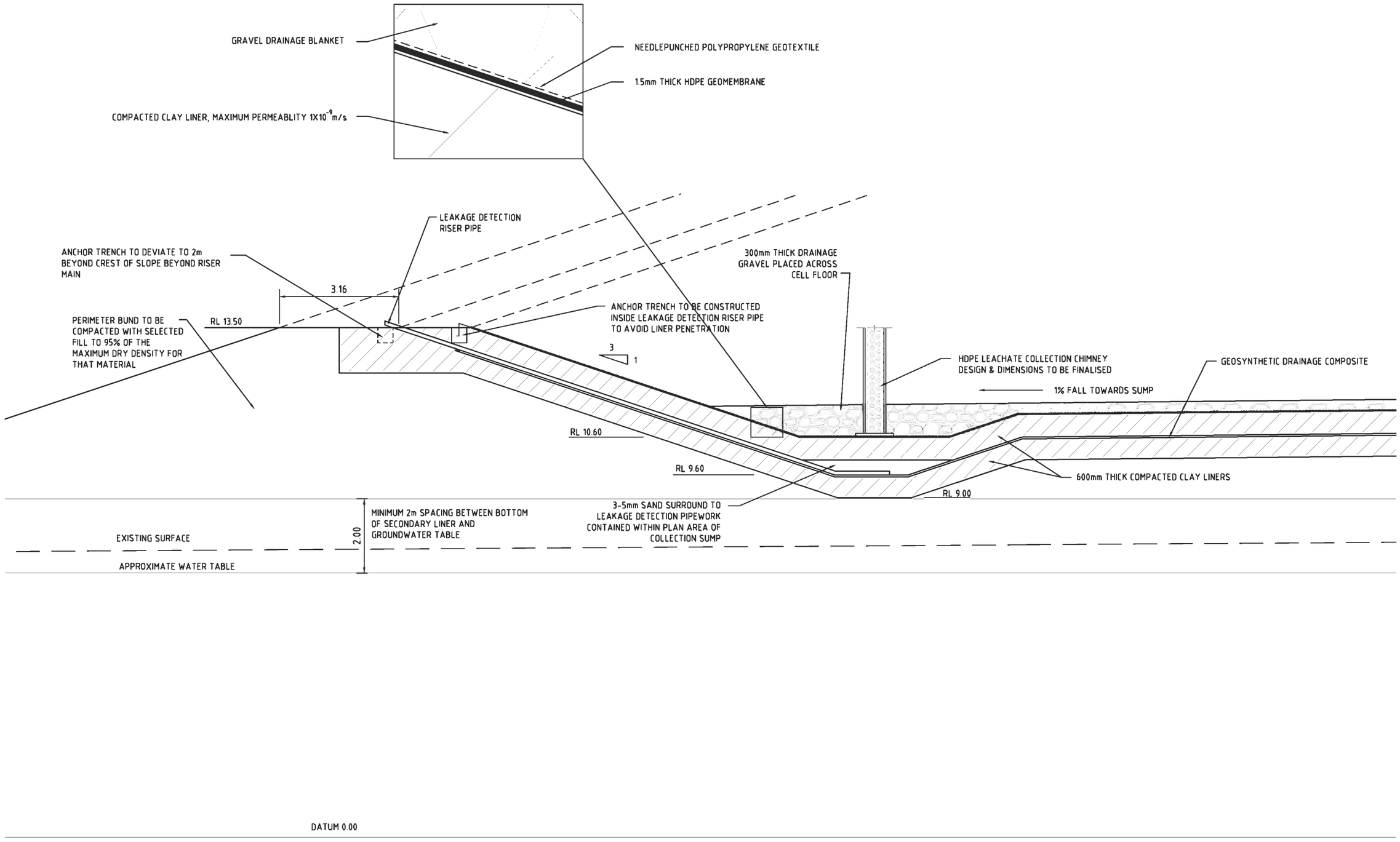
Project: I.W.S.
LOW LEVEL CONTAMINATED SOIL
CONCEPT DESIGN
SECTIONS

Job No: 2102250C

Drawing No: FIGURE 2

Sheet No.: 2

Rev:



ENLARGEMENT LEACHATE COLLECTION SUMP

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P:\A303\2102201-2102300\2102250\DRAFTING\2102250C\DRAWINGS\FIG 03.dwg, 30/04/2004 2:42:44 PM, Adobe PDF.pc3, 1:2

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		Date
Drawn	JM	03/04
Designed	MDL	03/04
Drawing Check	MDL	03/04
Design Check		03/04
Project Approval		03/04

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Client: INTEGRATED WASTE SERVICES

Project: I.W.S.
LOW LEVEL CONTAMINATED SOIL
CONCEPT DESIGN
DETAILS

Job No: 2102250C

Drawing No: FIGURE 3

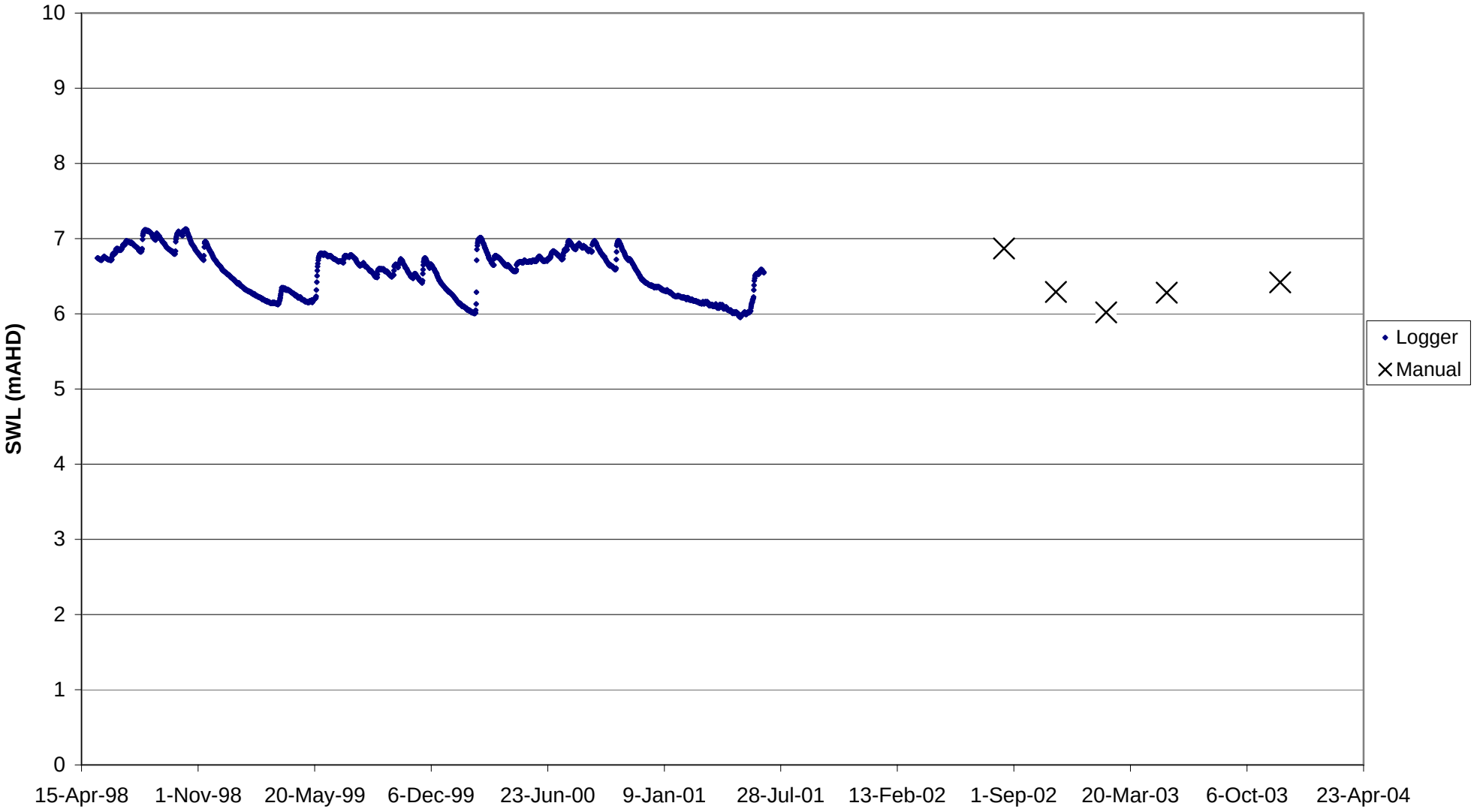
Sheet No.: 3

Rev:

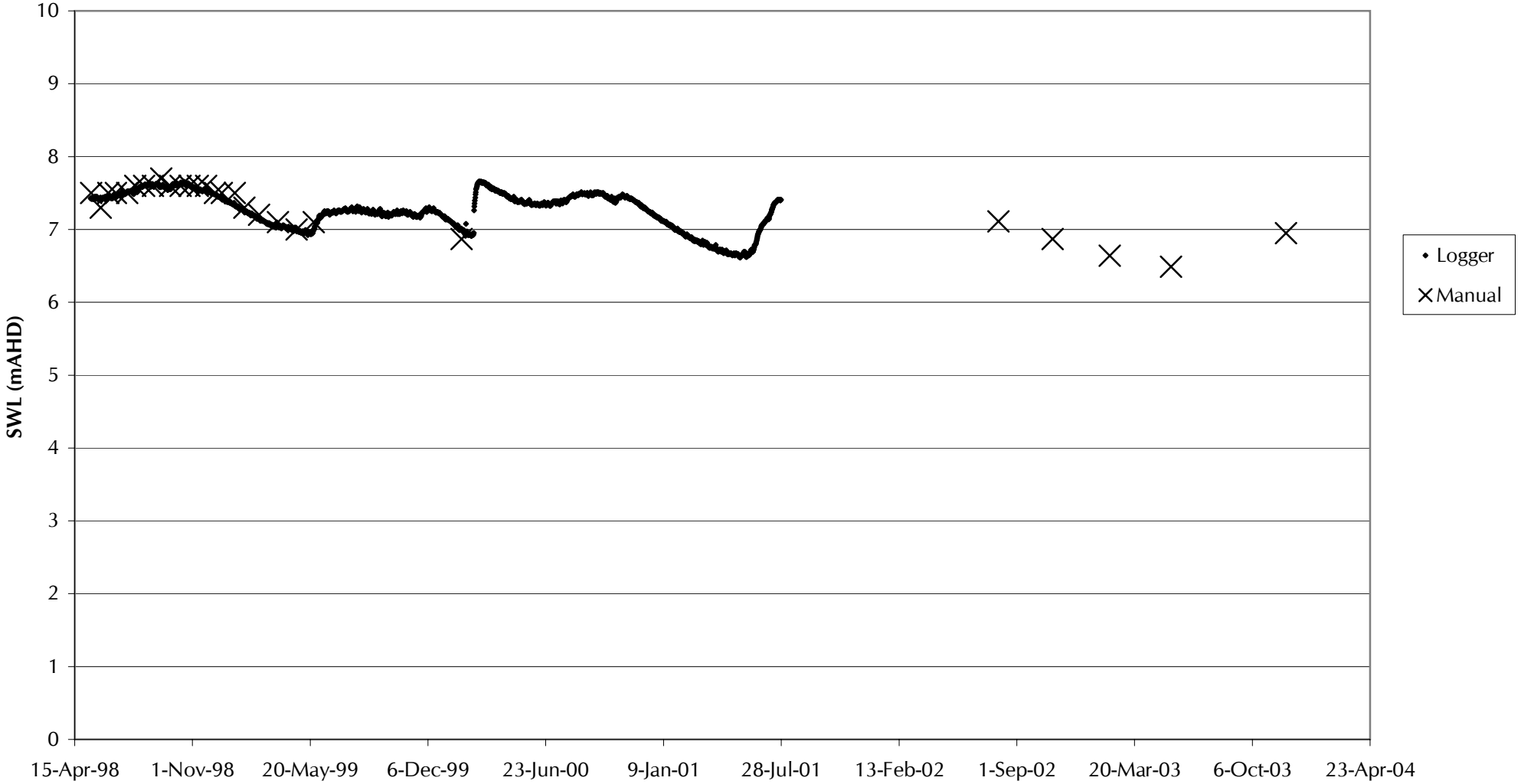
Appendix I

Groundwater Figures

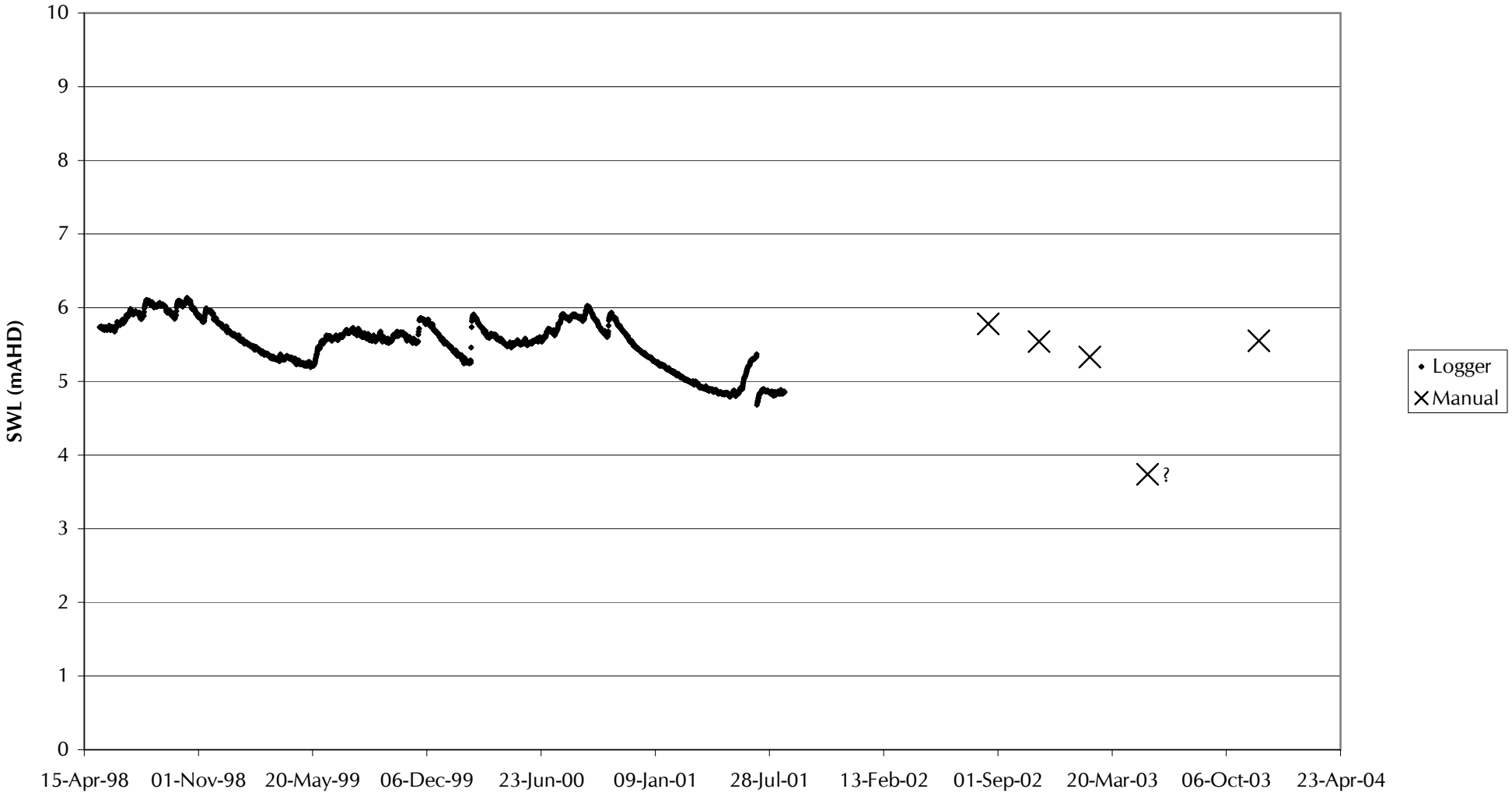
IWS Northern Balefill Monitoring Well GW3 Hydrograph



IWS Northern Balefill Monitoring Well GW4 Hydrograph



IWS Northern Balefill Monitoring Well GW5 Hydrograph



APPENDIX B

SUPPLEMENTARY INFORMATION

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Telephone (08) 8212 2900
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26 November 2004 04663307/022

The Development Assessment Commission
136 North Terrace
ADELAIDE SA 5000

Attention: Mr Roger Freeman
Principal Environmental Planner

Dear Sir

SUPPLEMENTARY INFORMATION
EIS AMENDMENT: RECEIPT OF LOW LEVEL CONTAMINATED SOIL AND LIQUID TREATMENT PLANT RESIDUES AT THE IWS NORTHERN BALEFILL

This document provides a supplement to the EIS Amendment: Receipt of Low Level Contaminated Soil and Liquid Waste Treatment Plant Residues at the IWS Northern Balefill.

In July 2003 Integrated Waste Services (IWS) lodged an application to amend the Development Authorisation and Environmental Protection Act License for the Northern Balefill Site operation. It is understood the application was undertaken as an amendment to the existing Environmental Impact Statement (EIS) under Section 47 of the *Development Act 1993*. The proposed amendment to the EIS was to permit the following additional materials to be received into the Balefill:

- Low Level Contaminated Soil (LLCS)
- Liquid Treatment Plant Residues (LTPR) left over from treating of liquid water and containing no free water.

In accordance with Section 47 of the Development Act 1993, the application is under assessment by Planning SA and has been the subject of consultation with government agencies and relevant stakeholders. Submissions were received and three subsequent response documents dated 21 November 2003, 30 January 2004 and the most recent dated 30 April (Response Document on the EIS Amendment for the Receipt of Low Level Contaminated Soil and Liquid Plant Residues (Revised) were prepared by Parsons Brinkerhoff Pty Ltd (PB) on behalf of IWS. It is understood that each version supercedes the previous one, and the 30 April 2004 version is current.

Golder Associates Pty Ltd has reviewed the Revised document of 30 April 2004 and assessed several areas where further clarification is warranted. This document is provided as a supplement to the Revised document in order to address the outstanding issues.

This document should be read in conjunction with the following documents:

- The EIS Amendment: Receipt of Low Level Contaminated Soil and Liquid treatment Plant Residues at the IWS Northern Balefill (July 2003)
- Response Document on the EIS Amendment for the Receipt of Low Level Contaminated Soil and Liquid Plant Residues (Revised), 30 April 2004 (PB reference 03-0785-03), which refers to the EPA response to Planning SA dated 19 September 2003

Summary of Technical Drawing Changes

Outlined below is a summary of key changes to LLCS cell technical detail made in accordance with comments from the SA EPA to submitted draft LLCS and LTPR environmental management requirements.

The updated technical drawings for LLCS and LTPR Cell 31 are provided in Attachment 2. Due to the inconsistencies identified in the previous versions of the drawings, these drawings supercede all previous technical drawings. The key changes to the drawings are as follow.

Sump Position

- The sump location has been moved to a site more central to the cell, approximately half way along the northern perimeter of the cell floor.
- Relocation of the sump reduces the flow path length for leachate at the extremities of the cell and aids in increasing air space in the cell.
- As a result of design changes associated with movement of the cell sump, the location of the leachate collection pipes have also been revised, with provision to flush the piping system included.

Sump RL

The RL at the base of the sump has been interpolated using the data from groundwater wells GW2, GW3 and GW4. There are several sources of survey information available from 1998 and as recently as June 2004 to refer to, some of which are inconsistent. These sources include the following:

1. The original data from 1998 (Baseline Groundwater Monitoring May 1998 to May 1999, Golder Associates)

2. Recent groundwater monitoring data (Annual Environmental Monitoring Report, June 2004 Parsons Brinkerhoff)
3. Graphically represented data from 1998 onwards. (Response Document on the EIS Amendment for the receipt of LLCS and LTPR (Revised)April 2004 Parsons Brinkerhoff)

- The tabulated data in No. 2 above is shown to be resurveyed. The tables include the original data from 1998 adjusted by survey. The resurvey has had the effect of lowering the AHD of the peak water levels.
- The charts in No. 3 above do not have supporting tables in the same document. Referencing the tables in No1 and No2 suggests the charts show recent data from No2 plotted with the earlier data from No1 (before resurvey). Some charts (eg GW3) do not correspond to either No1 or No2 in 1998.
- The highest AHD reading observed in any of the three water bores was in 1998 before the resurvey. As such this data has been used to check the design RLs.
- GA2, GA3, and GA4, located around Cell 31, have highest water levels reported at 7.0 mAHD, 6.8 mAHD and 7.7 mAHD, respectively. Interpolation of groundwater contours from these three location supports an upper groundwater level of 7.1 mAHD for design purposes.
- Based on the interpolation of water levels, the 2 m separation distance and including a 0.1 m buffer, the base of the sump is at 9.2 mAHD.

Leachate Collection

- The method of leachate collection has been changed from a vertical riser pipe to an inclined riser pipe installed against the side slope of the cell.
- An inclined riser allows leachate to be collected by means of a foot valve placed in the horizontal section of the riser pipe on the floor of the sump. The intake on a typical small diameter borehole pump in a vertical riser is usually located above the motor of the pump (typical 400mm). As such leachate below the intake level of the pump in the sump cannot be removed unless the pump is laid horizontally in the sump.
- The leachate collection pipes on the cell floor have been positioned at the base of the drainage aggregate, on top of the clay layer.
- Leachate will be collected by pumping into an appropriate onsite storage truck or managed as part of the leachate system for the site, which may include a leachate evaporation pond (subject to appropriate development approvals).

Leachate Flow Estimates

The rate at which leachate reaches the sump after a rain event is dependent on the cover of LLCS in the cell and the pipes. The leachate collection pipes specified have a capacity of 38L/s at 1% fall.

The rainfall intensity for a 10 year annual recurrence interval (ARI) 1 hour storm is estimated at 25mm/hr. Such an event will produce approximately 235m^3 of runoff (approximately 112m^3 in the west and 122m^3 in the west. The peak flow rate to the sump from such an event, and while the cell is empty, is estimated at approximately 66L/s through the two pipes and gravel (approximately 33L/s through each 38L/s capacity pipe). Such conditions will only exist for a few weeks duration between completion of the cell construction and receiving of the first waste. To accommodate the runoff from such a storm event during this period, a submersible pump of high flow capacity (40 to 50L/s) will be available on site to be placed in the sump if required. Once the cell is being filled with waste and the first layer of waste covers the base of the cell, the flow rate in the collection system is expected to be significantly less than 1L/s. The capacity of the sump, once the cell base is covered with waste, is estimated at numerous hours of leachate flow, depending on climate conditions and the moisture content of the waste.

Medium and longer term leachate flows collected and directed to the sump will be pumped from a lower flow rate pump in the sump riser.

Distance Between LLCS and Balefill Cell

- The distance between a LLCS cell and an adjacent Balefill Cell is specified as 5 m horizontally between the toe of the LLCS cell structure and the cap of the nearest balefill cell.
- The toe of the LLCS cell structure is where the outer surface of the cap of a completed LLCS cell joins the outer surface of the underlying clay liner perimeter bund for the same cell. This is approximately 5m horizontal distance from the LLCS.
- The cap of the nearest balefill cell is where the outer surface of the cap of a completed balefill cell joins the outer surface of the underlying clay liner for the same cell. This is approximately 5m horizontal distance from the balefill material

Summary of Environmental Management Changes

Outlined below is a summary of key changes to the LLCS & LTPR Cell environmental management. These changes have been made in accordance with feedback from the SA EPA and Planning SA to the submitted draft LLCS and LTPR environmental management requirements. The updated LLCS and LTPR LEMP section is provided in Attachment 1, which is for incorporation into the existing approved Northern Balefill LEMP (2001) and supercedes Appendix C: *Additional LEMP Chapter for LLCS Cells* and Appendix F: *Surface Water Management* of the Response Document, April 2004. Updated drawings are provided in Attachment 2.

The site is managed according to the controls outlined within the two main site management documents; the IWS Northern Balefill Operating Manual and approved LEMP (2001). A revised LEMP incorporating the approved LLCS and LTPR Section (refer Attachment 1) supercedes the 2001 document.

Section 17.1: Cell Design and Construction

- Outlines cell design and construction including location (refer Drawing 3307D05) and updated detail regarding lining and leachate collection system, refer Drawing 3307D01 - D04.
- A suitably qualified geotechnical engineer will undertake detailed design of lining and leachate collection system. A Construction Quality Assurance Program will be implemented as part of cell construction. It will consider inspection and testing of material, placement, connections and workmanship. Inspection and testing of the compacted clay liner will be carried out under Level 1 engagement in accordance with Appendix B of AS3798:1996 "*Earthworks for Residential and Commercial Developments"*. A completion report including a statement of completion will be prepared, which documents the as-built details and results of the program of Quality Assurance inspection and testing, and confirms (or otherwise) compliance with the approved design.
- Buffer distance boundaries are defined.

Section 17.2: LLCS and LTPR Acceptance Requirements

- Details waste tracking certificate and information requirements, including
- IWS reserve the right to request suitably qualified environmental consultant classification prior to accepting material
- Load inspection, including reference to responsible onsite personnel
- Approach to additional analyte regime

Section 17.3: General LLCS and LTPR Management

- Onsite personnel training for load inspection duties and development of gate house procedures.
- LLCS and LTPR waste from different sources will not be mixed
- LLCS and LTPR waste received from different sources will be deposited in different parts of the low level cell to minimise the potential for direct physical contact. Daily cover layer spread will also prevent this.
- Daily cover will be monitored as part of ongoing operations for stability and maintenance of material cover. Depth of daily cover may be increased based upon performance review, in the event of extreme weather events, or if the area is required as part of an access point to minimise potential for vehicle wheel cover.

Section 17.4 Groundwater and Leachate Management

Groundwater

- An additional groundwater well will be installed west of Cell 30 prior to construction of the first LLCS cell. Sampling will be initiated prior to operation of the cell.

Groundwater monitoring will include:

- Three monitoring rounds in the first 12 months at six monthly intervals to establish additional background analyte levels around LLCS cells. Analysis will be undertaken in accordance with analytes described in Section 5 of the LEMP, that is, as outlined in EPA (1999) *Guidelines for the Development of a Groundwater Monitoring Program for Waste Disposal Depots (EPA, 1999)*, Table 1. In addition to these analytes samples will also be analysed for the presence of volatile organic compounds (VOCs).
- Six monthly monitoring rounds will be undertaken at the completion of the initial 12 months of groundwater monitoring. Samples will be assessed for the trigger analytes as described in Section 5 of the LEMP, that is, as outlined in EPA (1999) Table 1. If VOCs are present then those VOCs will be added to trigger parameter lists for affected monitoring wells. If no cost savings are available for individual VOC analysis a full scan will be undertaken.
- Background sampling results and Environment Protection Policy (Water Quality) water quality criteria will be used for comparative analysis of groundwater sample results, together with trend analysis with time.

Leachate

- Leachate from the LLCS & LTPR will not be recirculated.
- Leachate level monitoring will include daily readings of the cell leachate level data logger and a weekly manual review. Cell leachate levels will be reviewed manually subsequent to high rainfall events. Details of leachate level monitoring will be reported to the EPA quarterly.
- Leachate will be removed if present at greater than 300 mm above the cell floor (600 mm above the sump floor). To facilitate this, a trigger level for pumping will be set at 290 mm above the cell floor. Pumping of leachate will commence prior to leachate level reaching 290 mm.
- A manual monitoring probe will be calibrated to directly read the vertical elevation of leachate in the riser pipe. Depth of the probe in the riser pipe will be checked against a fixed reference point at the opening of the riser pipe.
- Data logger readings will be downloaded weekly and adjusted accordingly to provide leachate level information.
- Leachate will be stored in onsite IWS liquid storage vehicles prior to disposal.
- Leachate analysis will include volatile organic compounds (VOCs) and the analytes, as listed in section 5 of the LEMP (2001) and in accordance with the EPA (1999) *Guidelines for the development of a Groundwater Monitoring Program for Waste Depots*.
- If leachate sampled contains VOCs (59 USEPA Priority List) in quantities greater than the SA Environment Protection Policy for Water Quality or existing baseline data, then they will be added to trigger parameter lists for potentially affected nearby groundwater monitoring wells.
- Leachate will be disposed of to an appropriately licensed offsite Liquid Waste Treatment Plant or alternately an onsite evaporation basin may be constructed in the future subject to EPA approval. Leachate analysis will be undertaken prior to disposal to any such facilities for the list of analytes in Section 5 of the LEMP (2001).

Section 17.5: Air Quality Management

- In accordance with previous 'worst case' scenario air dispersion modelling, the low level cells are unlikely to pose a threat to offsite receptors.
- Odour and Hazardous VOCs Air Monitoring

It should be noted that landfill gas meters typically measure oxygen, carbon dioxide and methane. Carbon dioxide and methane are colourless and odourless and typically form about 99% of landfill gas. A landfill gas meter will therefore not be useful in quantifying odours that may result from the remaining gas emissions or detecting hazardous VOCs.

Further to this, PID meters are typically not used for odour monitoring and are designed to measure ioniseable volatile organic compounds. PIDs are typically calibrated to measure benzene and light fraction petroleum hydrocarbons. The chemical range of measurable hazardous VOCs does not represent a large proportion of hazardous VOCs or odourous compounds.

Since material accepted to the landfill is tested to a limiting criteria of analytes it is considered this is not warranted for monitoring with either landfill gas or PID meter as part of normal operations. Further to this, neither the landfill gas or PID monitors are specifically suited to measure odour or hazardous VOCs.

- Air quality complaints will be addressed in accordance with section 17.5 and section 3.7 of the LEMP.
- All incoming LLCS or LTPR will be reviewed and inspected by onsite personnel, refer section 17.2. If in the opinion of the onsite personnel responsible for load inspection receiving waste contains undue mal-odours then, daily cover will be placed over the load upon receipt to the low level cell within a 2 hour period.
- Dust control is outlined in section 17.5.1

Section 17.6 Noise Management

No substantial changes.

Section 17.7 Surface Water Management

- Internal Drainage System
  - If leachate occurs it shall be tested and exported either for licensed liquid treatment plant disposal or disposed of to an approved onsite evaporation pond (refer section 17.4.2). Transport will be either by a suitable storage truck or sealed pipe system.
  - Row 2 deleted.

- Internal Stormwater Management
  - A 1 metre high bund will be constructed around the perimeter of the four cells proposed for LLCS and LPTR to divert stormwater flowing from the north.
  - Open drains will be created adjacent the outside toe of the bunds to assist the flow around the cells.
  - Water will be diverted towards the evaporation pond area to the south west of these cells as shown in Drawing 3307D08 & 3307D09.
- Monitoring and Corrective Action
  - During construction all stormwater and temporary sedimentation control devices will be inspected weekly and maintained to ensure effectiveness.
  - All stormwater installations will be inspected monthly and maintained to ensure effectiveness.
  - All stormwater installations will be inspected to ensure effectiveness during and after major storm events (defined as greater than 25mm rainfall in 24 hours), as required.
  - The EPA will be notified of any stormwater contamination in the event of discharge from a sediment pond.

Section 17.8 Wheel Wash Management

- All vehicles shall be confined to designated onsite roads, tracks and work areas to minimise the potential for contact with LLCS or LTPR waste material.
- An additional wheel wash facility will be constructed adjacent to the low level cells to remove any material from vehicle wheels prior to leaving the environ of the low level cells.
- All vehicles will use the designated LLCS / LTPR wheel wash facility prior to departing the low level cell area to ensure wheels are free of any potential LLCS and/or LTPR material.
- Wheel wash sediment will be periodically removed for disposal to the active low level cell.
- The LLCS / LTPR wheel wash facility will be inspected regularly to ensure effectiveness and maintained, as required.
- Wheel wash facility maintenance activities will not be carried out during LLCS or LTPR vehicle delivery activity onsite.
- Water from the wheel wash facility will be disposed of to an appropriately licensed treatment facility or alternately a suitably lined onsite evaporation basin may be constructed in the future subject to EPA approval.

Section 17.9 Closure and Post Closure

No substantial changes.

Should you have any queries or require any further information please contact the undersigned.

Yours faithfully
GOLDER ASSOCIATES LTD.

Andrew Proudman
Senior Geotechnical Engineer

Adam Kilsby
Associate

Attachments :

Attachment 1 LLCS & LTPR Section for Inclusion in approved LEMP (2001) – 'Section 17'
Attachment 2 Revised Technical Drawings for LLCS & LTPR Cell

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Cc: Marina Wagner, Environment Protection Authority

ATTACHMENT 1

LOW LEVEL CONTAMINATED SOIL & LIQUID TREATEMENT PLANT RESIDUE SECTION FOR INCLUSION IN APPROVED LEMP (2001) 'SECTION 17'

SECTION 17

17 Additional Environmental Management Requirements for Low Level Contaminated Soil & Liquid Treatment Plant Residue

Low Level Contaminated Soil (LLCS) and Liquid Treatment Plant Residue (LTPR) will be managed in accordance with the general environmental management requirements of the EPA approved IWS Northern Balefill Landfill Environmental Management Plan (LEMP).

This section outlines the additional management measures required for the specialised conditions associated with LLCS and LTPR waste management, and will be incorporated into the LEMP subsequent to EPA approval. Related documents include:

- *EIS Amendment: Receipt of LLCS and LTPR at the IWS Northern Balefill*, July 2003
- *Response Document on the EIS Amendment for the Receipt of LLCS and LTPR (revised)*, 30 April 2004, (PB reference 03-0785-03).
- *IWS Northern Balefill, Landfill Environmental Management Plan (LEMP)*, August 2001

17.1 Cell Design and Construction

The location of the proposed cells to receive LLCS and LTPR are Cells 25, 26, 30 and 31, as detailed on Drawing 3307D05

Design and construction for the lining and leachate collection system will be in accordance with section 8.4 of the EIS Amendment (2003), refer Drawings 3307D01 - D04.

Detailed design of lining and leachate collection system will be undertaken by a suitably qualified geotechnical engineer. A Construction Quality Assurance Program will be implemented as part of cell construction. It will consider inspection and testing of material, placement, connections and workmanship. Inspection and testing of the compacted clay liner will be carried out under Level 1 engagement in accordance with Appendix B of AS3798:1996 "*Earthworks for Residential and Commercial Developments"*. A completion report including a statement of completion will be prepared, which documents the as-built details and results of the program of Quality Assurance inspection and testing, and confirms (or otherwise) compliance with the approved design.

The 5m buffer between low level and balefill cells shall refer to the horizontal distance between the two points below:

1. The toe of the LLCS cell structure, that is, where the outer surface of the cap of a completed LLCS cell joins the outer surface of the underlying clay liner perimeter bund for the same cell. This is approximately 5m horizontal distance from the LLCS.

2. The cap of the nearest balefill cell, that is, where the outer surface of the cap of a completed balefill cell joins the outer surface of the underlying clay liner for the same cell. This is approximately 5m horizontal distance from the balefill material.

17.2 LLCS and LTPR Acceptance Requirements

The following waste information requirements will apply to the receipt of all LLCS and LTPR to the site. No LLCS or LTPR will be accepted without prior arrangement or review of all required documentation. Details are outlined below:

- No LLCS will be accepted to the low level cell unless it meets the Criteria for the Receipt of Contaminated Soil, (refer Attachment 1, suggested addition to LEMP (2001) as Appendix 9).
- All LLCS must be accompanied by relevant documentation, including Waste Tracking Certificates and NATA laboratory certified documentation confirming compliance with LLCS criteria. IWS may request LLCS classification confirmation from a suitably qualified environmental consultant.
- LTPR will only be accepted from licensed liquid treatment plants (for example: Cleanaway, Wingfield and Collex, Kilburn).
- All LTPR must be transported by appropriately licensed vehicles (for example: Cleanaway and Collex) in accordance with current EPA waste transport guidelines and requirements.
- No LTPR will be accepted unless accompanied by relevant documentation, including Waste Tracking Certificates and documentation confirming compliance with nominated criteria , (refer Attachment 1, suggested addition to LEMP (2001) as Appendix 9).
- It is a site requirement that all incoming loads are covered.
- Onsite personnel will visually inspect all waste loads for conformity with documentation.
- Material will not be accepted if upon inspection, prior to entering the low level cell, it does not appear to meet the expected conditions outlined in related waste management documentation.
- Additional analyte testing may be required if onsite personnel have any queries regarding LLCS or LTPR, subsequent to waste information review or visual inspection. A suitably qualified environmental consultant will advise on any further testing regime, including analytes not specified in Attachment 1, (addition to LEMP (2001) as Appendix 9).

17.3 General LLCS and LTPR Management

Additional general environmental management measures that will apply to the receipt and disposal of LLCS and LTPR onsite include:

- All onsite personnel responsible for load inspection will receive training in waste material awareness prior to commencement of these duties and be provided with gate house procedures.
- LLCS and LTPR waste from different sources will not be mixed
- LLCS and LTPR waste received from different sources will be deposited in different parts of the low level cell to minimise the potential for direct physical contact. Daily cover layer spread will also prevent this.
- All LLCS and LTPR placed in the low level cell will be covered by a minimum layer of 150mm day cover at the close of business each day;
- Daily cover will be monitored as part of ongoing operations for stability and maintenance of material cover. Depth of daily cover may be increased based upon performance review, in the event of extreme weather events, or if the area is required as part of an access point to minimise potential for disturbance and spreading by vehicles.

17.4 Groundwater and Leachate Management

Groundwater and leachate management will be undertaken in accordance with Section 5 of the LEMP, and include the following additional management requirements.

17.4.1 Groundwater Monitoring and Analysis

Existing groundwater monitoring wells GW3 and GW4 are upgradient of the LLCS cell location and GW5 downgradient. An additional groundwater well will be installed west of Cell 30 prior to construction of the first LLCS cell. Sampling will be initiated prior to operation of the cell.

Groundwater monitoring will include:

- Three monitoring rounds in the first 12 months at six monthly intervals to establish additional background analyte levels around LLCS cells. Analysis will be undertaken in accordance with analytes described in Section 5 of the LEMP, that is, as outlined in EPA (1999) *Guidelines for the Development of a Groundwater Monitoring Program for Waste Disposal Depots (EPA, 1999)*, Table 1. In addition to these analytes samples will also be analysed for the presence of volatile organic compounds (VOCs).
- Six monthly monitoring rounds will be undertaken at the completion of the initial 12 months of groundwater monitoring. Samples will be assessed for the trigger analytes as described in Section 5 of the LEMP, that is, as outlined in EPA (1999) Table 1. If VOCs

are present then those VOCs will be added to trigger parameter lists for affected monitoring wells.

- Background sampling results and Environment Protection Policy (Water Quality) water quality criteria will be used for comparative analysis of groundwater sample results.

17.4.2 Low Level Cell Leachate Management

The rate of leachate generation is expected to be low, based upon site knowledge, and HELP modelling. Leachate may be required for removal from cells, particularly during high rain periods. If this is required the following management options will be applied.

- Daily readings of the cell leachate level data logger will be taken, as well as, weekly manual leachate level review. Details of leachate level monitoring will be reported to the EPA quarterly.
- Leachate will be pumped if present at greater than 300 mm above the cell floor (600 mm above the sump floor). To facilitate this, a trigger level for pumping will be set at 290 mm above the cell floor. Pumping of leachate will commence prior to leachate level reaching 290 mm.
- A temporary high flow pump will be installed during construction and monitored.
- A manual monitoring probe will be calibrated to directly read the vertical elevation of leachate in the riser pipe. Depth of the probe in the riser pipe will be checked against a fixed reference point at the opening of the riser pipe.
- Data logger readings will be downloaded weekly and adjusted accordingly to provide leachate level information.
- Leachate will be stored in onsite IWS liquid storage vehicles prior to disposal.
- Leachate analysis will include volatile organic compounds (VOCs) and the analytes, as listed in section 5 of the LEMP and in accordance with the EPA (1999) *Guidelines for the development of a Groundwater Monitoring Program for Waste Depots*.
- If leachate sampled contains VOCs (as outlined in 59 USEPA Priority List) in quantities greater than the SA Environment Protection (Water Quality) Policy 2003 or existing baseline data, then they will be added to trigger parameter lists for potentially affected nearby groundwater monitoring wells.
- Leachate will be disposed of to an appropriately licensed offsite Liquid Waste Treatment Plant or alternately an onsite evaporation basin may be constructed in the future subject to EPA approval. Leachate analysis will be undertaken prior to disposal to any such facilities for the list of analytes in Section 5 of the LEMP (2001).

17.5 Air Quality Management

Air quality management will be undertaken in accordance with Section 9 of the LEMP, and include the following additional precautionary measures.

- Prior to LLCS or LTPR being accepted to site all required documentation will be reviewed and waste loads inspected for compliance, refer section 17.2.
- Material will not be accepted if upon inspection prior to entering the low level cell it does not appear to meet the expected conditions outlined in related waste tracking and management documentation.
- It is a site requirement that all incoming loads are covered.
- Daily cover will be placed over all LLCS / LTPR placed within a low level cell as part of daily site maintenance.
- If, in the opinion of the onsite personnel responsible for load inspection (refer section 17.3), the receiving waste contains undue mal-odours, then daily cover will be placed over the load upon receipt to the low level cell within a 2 hour period.
- Any air quality complaints received will be recorded in the site complaint register and addressed in accordance with section 3.7 of the LEMP.

17.5.1 Dust Control

- Dust suppression will be undertaken as required, in accordance with Section 9.5 of the LEMP.
- Any dust complaints will be recorded in the site complaint register and addressed in accordance with section 3.7 of the LEMP.
- Staff will visually monitor low level cells during normal operation for excessive dust generation.

17.6 Noise Management

Potential landfill noise impact assessment was undertaken during 2002 and concluded operations were within EPA criteria for noise. Low level cell operations will not alter the nature of current site operations and are not expected to impact upon surrounding properties. Noise management will be undertaken as part of the general requirement outlined in section 9.5 of the LEMP.

17.7 Surface Water Management

Section 7 outlines general site surface water management details, and low level cells will operate in accordance with the general details outlined in sections 7.1, 7.2, 7.3 and 7.5. During construction and filling of the low level cells stormwater will be diverted around the cells, as is undertaken for existing balefill cells, refer figure 9.1 of the *EIS Amendment for Receipt of LLCS and LTPR*.

The following surface water management plan will apply in addition to section 7 to the LLCS & LTPR cell operation and construction.

Sedimentation Ponds	Implemented	To be Implemented
The sedimentation ponds have been designed to capture eroded sediments from cleared areas of completed and capped balefill areas before vegetation is established on these surfaces. Each pond is 2 m deep with a length to width ratio of 3:1 as recommended by the CALM method (IEAust [QLD] Erosion and Sediment Control Guidelines, June 1996). The ponds have been designed to accommodate a 1 in 25 year ARI, 24 hour duration storm. The pond locations have been selected so as not to interfere with existing established vegetation.		✓
Under normal operating conditions, water will either be allowed to evaporate or used for dust control purposes. A weir at the end of each sedimentation pond will allow overflow of water back into the external drainage water system in the event of a large storm. As this project is staged, all drains and sedimentation ponds will be built as required, not simultaneously, and discontinued only after rehabilitation of previous stages is completed. The ponds are designed to reduce the water velocity by interrupting the flow and allowing suspended sediments to settle.		✓

External Surface Water Diversion System	Implemented	To be Implemented
Drawings 3307D08 and 3307D09 and accompanying Specifications and Design Plans shows the interim stormwater drainage structures. Surface water control is provided for Stages 1, 2 and 3 of the site development by the interim stormwater drainage structures. For location of stages, refer to Balefill Staging Plan Drawing 3307D05. Further detail of interim drainage during the progressive development of the four low-level cells is given in the accompanying figure.		✓
The Interim external surface water drainage system will use a section of existing large borrow pits as a stormwater containment/evaporation basin.		✓
All water from on-site works and currently impinging catchments, will be diverted to these basins. External surface water not affected by the interim works will be allowed to continue across the site as at present.		✓

Internal Drainage System	Implemented	To be Implemented
For the stages of the development beyond the interim case, sediment contact water drains and sediment / evaporation ponds as shown on Drawing 3307D06 will be progressively developed to ensure that adequate capacity is maintained. It is noted that this system is shown separate from the external surface water drains. Engineering details showing areas of cut and fill (if required) will be provided with the detailed design drawings for EPA endorsement prior to cell construction. If leachate occurs, it shall be tested and exported for disposal to a licensed liquid treatment plant or to an approved onsite evaporation pond (refer section 17.4.2).		✓

On-site Sediment Contact Water Management System	Implemented	To be Implemented
Refer to the attached staging plan, Drawing 3307D05. Intercept on-site surface water that has come into contact with disturbed surfaces and stockpiles, (excluding waste) and direct this flow to the sedimentation pond.		✓

Internal Stormwater Diversion System	Implemented	To be Implemented
Diversion drains and bunding will be used to minimise the volume of potential waste contact water by diverting the water away from the waste. • A 1 metre high bund will be constructed around the perimeter of the four cells proposed for LLCS and LPTR to divert stormwater flowing from the north. • Open drains will be created adjacent the outside toe of the bunds to assist the flow around the cells. • Water will be diverted towards the evaporation pond area to the south west of these cells as shown in Drawings 3307D08, D09 &D10.		✓

Maintenance	Implemented	To be Implemented
Avoid overflow of drains by removing silt to restore the original profile. This will be incorporated into the routine site inspection and maintenance schedule.		✓
Repair any damage to channels that may reduce their functionality.		✓
Long term sediment build up will be collected. Disposal will be into the landfill in accordance with authorisation.		✓
Rebuild bunds as necessary if damage occurs at the landfill face.		✓
Review operational work procedures and adequacy of design.		✓
Construct drainage surfaces and channels to control new or alternate drainage lines.		✓

Monitoring and Corrective Action	As required	Daily	Weekly	Monthly
During construction all stormwater and temporary sedimentation control devices, and temporary pumps, will be inspected and maintained to ensure effectiveness.			✓	
All stormwater installations will be inspected and maintained to ensure effectiveness.				✓
All stormwater installations will be inspected visually to ensure effectiveness during and after major storm events*.	✓			
The EPA will be notified of any stormwater contamination in the event of discharge from a sediment pond.	✓			

*major storm event is defined as a 10 year recurrence 25 mm rainfall in 1 hour event

17.8 Wheel Wash Management

The site wheel wash facility aims to minimise the offsite transport of soil and related materials from the landfill site by related vehicle movement.

- All vehicles shall be confined to designated onsite roads, tracks and work areas to minimise the potential for contact with LLCS or LTPR waste material.
- An additional wheel wash facility will be constructed adjacent to the low level cells to remove any material from vehicle wheels prior to leaving the environ of the low level cells.
- All vehicles will use the designated LLCS / LTPR wheel wash facility prior to departing the low level cell area to ensure wheels are free of any potential LLCS and/or LTPR material.
- Wheel wash sediment will be periodically removed for disposal to the active low level cell.
- Water from the wheel wash facility will be disposed of to an appropriately licensed treatment facility or alternately an onsite evaporation basin may be constructed in the future subject to EPA approval.
- The LLCS / LTPR wheel wash facility will be inspected regularly to ensure effectiveness and maintained, as required.
- Wheel wash facility maintenance activities will not be carried out during LLCS or LTPR vehicle delivery activity onsite.

17.9 Closure and Post Closure Management

Closure and post closure management will be undertaken in accordance with section 16 of the LEMP, and the additional management items outlined below:

- Leachate monitoring during closure and post closure will be undertaken in accordance with section 5 of the LEMP and section 17.4; and
- Groundwater monitoring in the vicinity of low level cells during closure and post closure will be undertaken in accordance with Section 17.4.

Attachment 1

Addition to LEMP (2001) as
Appendix 9: Criteria for Receipt of Contaminated Soil

ATTACHMENT 2

REVISED TECHNICAL DRAWINGS FOR LLCS AND LTPR CELLS

LEACHATE COLLECTION PIPE

LEACHATE DETECTION PIPE

LEACHATE COLLECTION SUMP

CREST OF EMBANKMENT
RL 13.5m WIDTH 5m

A D02

RISER BUNDING

LEACHATE SUMP RISER
EXTRACTION PIPE

TOP OF LINER RIDGELINES
SHOWN DASHED

JOIN TO NATURAL
SURFACE LEVEL

1V : 3H

RL 11.99m

RL 11.85m

2%

RL 10.90m

RL 12.52m

RL 12.81m

RL 12.40m

1%

C D03

RL 11.16m

CELL 31

SOLID RISER PIPE ON BATTER
SLOPE FOR FLUSHING OF
LEACHATE COLLECTION PIPES

RL 11.63m

2 x 180mm Ø PIPES
SPACED < 300mm APART
1m RADIUS AT BEND

RL 11.85m

GEOSYNTHETIC ANCHOR
TRENCHING

B D03

SOLID RISER PIPE ON BATTER
SLOPE FOR FLUSHING OF
LEACHATE COLLECTION
PIPES

RL 12.49m

BATTER SLOPE 1V : 3H

CELL 26

LEGEND

● RL 12.20m - SURFACE ELEVATION AT BASE OF AGGREGATE m(AHD)

0 10 20 30 40
SCALE IN METRES

CELL 30

CELL 25

REVISION	DESCRIPTION	INITS	DATE	INITS	DATE
				CHECKED	APPROVED
P2	REVISED PRELIMINARY ISSUE				
P1	REVISED PRELIMINARY ISSUE				
P0	PRELIMINARY ISSUE				

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CLIENT: INTEGRATED WASTE SERVICES PTY LTD

PROJECT: LOW LEVEL CONTAMINATED SOIL CELL

DRAWN	DATE	DRAWING CHECK	DATE
TJM	4/11/04		
DESIGNED	DATE	DESIGN CHECK	DATE

DRAWING TITLE: CELL 31 DESIGN PLAN

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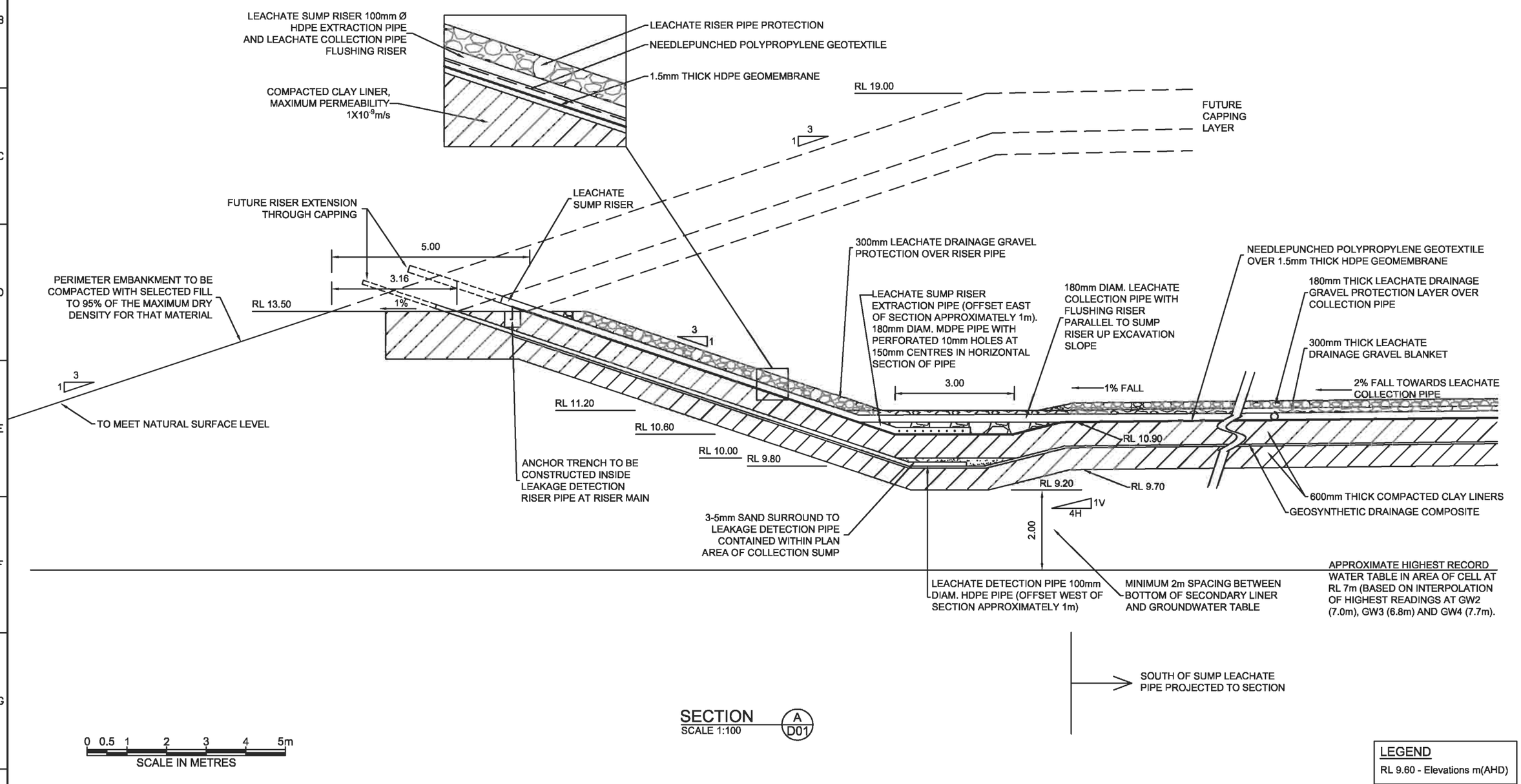

SECTION A
SCALE 1:100 D01

0 0.5 1 2 3 4 5m
SCALE IN METRES

LEGEND
RL 9.60 - Elevations m(AHD)

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P1	REVISED PRELIMINARY ISSUE				
P0	PRELIMINARY ISSUE		24/8		
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CLIENT	INTEGRATED WASTE SERVICES
PROJECT	LOW LEVEL CONTAMINATED SOIL CELL
DRAWN	CRC 25/08/04
DRAWING CHECK	
DESIGNED	
DESIGN CHECK	
AUTHORISED	
DRAWING TITLE	SECTION A LINER AND SUMP DESIGN
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PROJECT No	04663307
DRAWING No	3307D02
REVISION	P1

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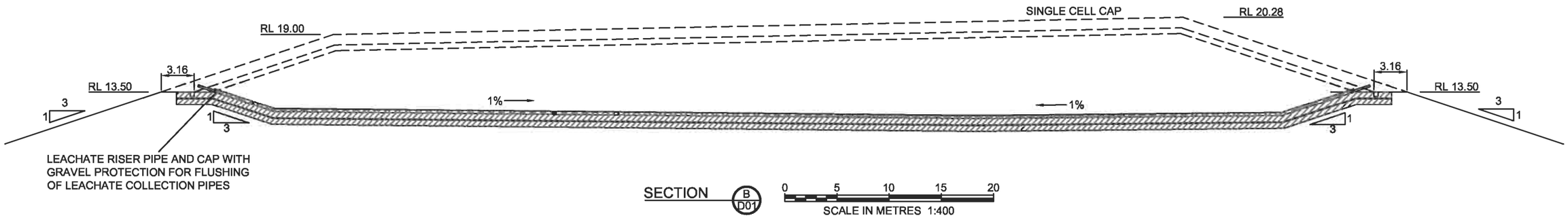

SECTION B/D01

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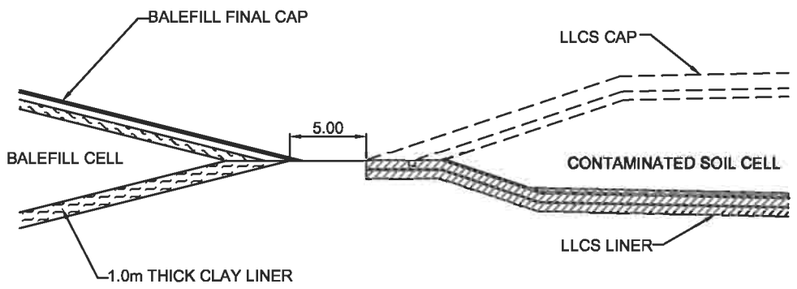

TYPICAL DETAIL OF DISTANCE BETWEEN BALEFILL CELL AND LLCS CELL

0 5 10 15 20

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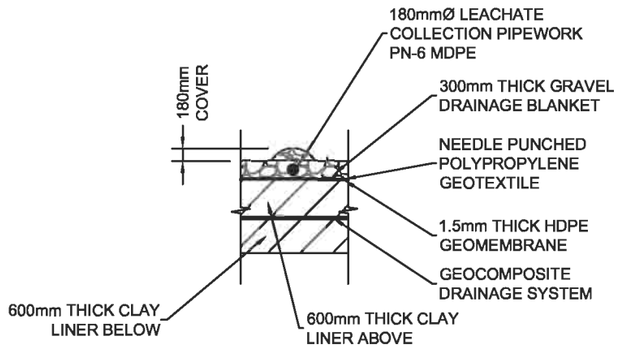

SECTION THROUGH LEACHATE COLLECTION DRAIN

SECTION C/D01

0 1 2 3 4

SCALE IN METRES 1:100

REVISION	DESCRIPTION	INITS	DATE CHECKED	INITS	DATE APPROVED
P1	REVISED PRELIMINARY ISSUE				
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CLIENT: INTEGRATED WASTE SERVICES

PROJECT: LOW LEVEL CONTAMINATED SOIL CELL

DRAWN: CRC	DATE: 10/08/04	DRAWING CHECK:	DATE:
DESIGNED:	DATE:	DESIGN CHECK:	DATE:
AUTHORISED:	DATE:	SCALE: AS SHOWN	A3

DRAWING TITLE: LINER DESIGN SECTIONS AND DETAILS

PROJECT No: 04663307 | DRAWING No: 3307D03 | REVISION: P1

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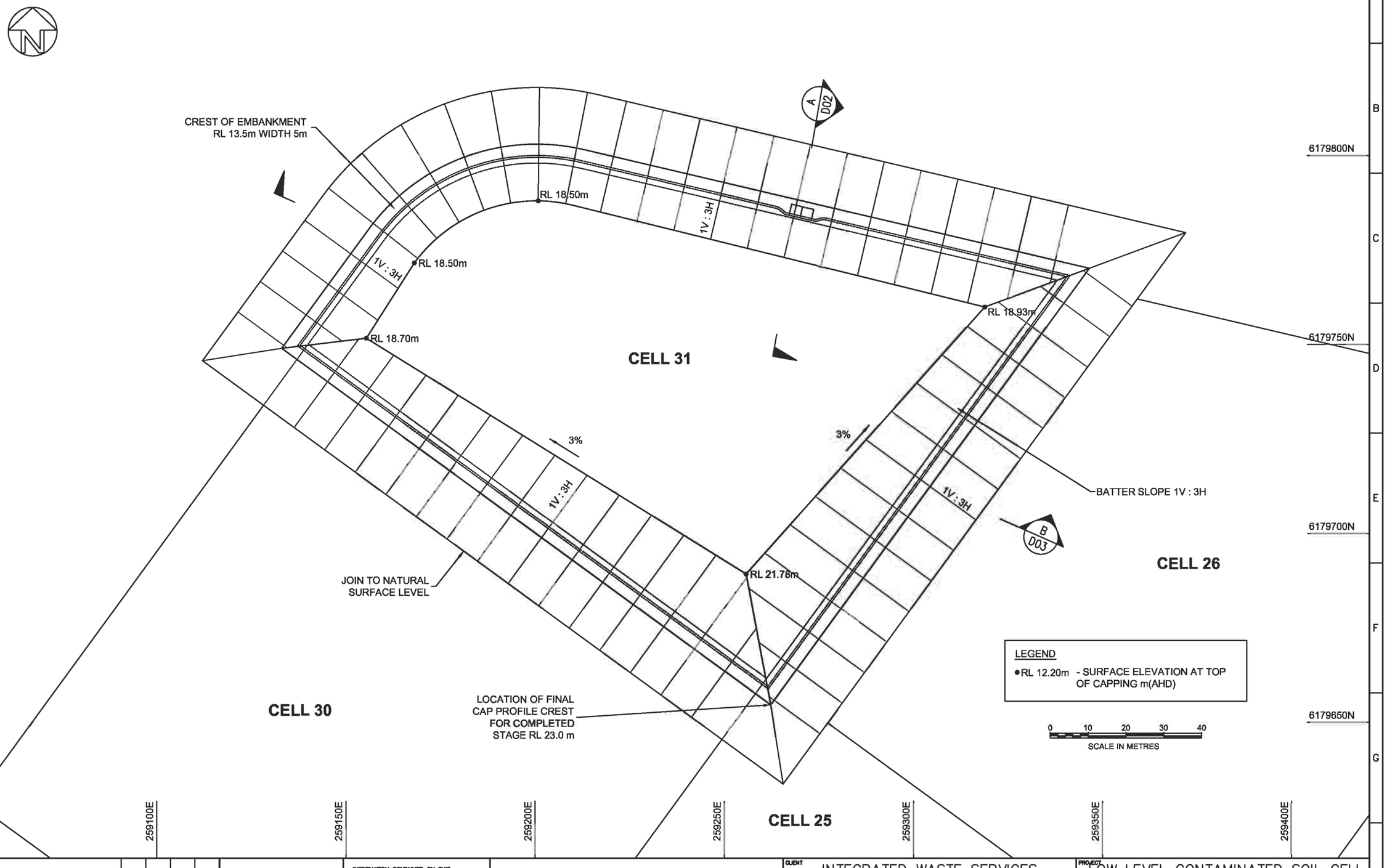

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P0	PRELIMINARY ISSUE		24/8		
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CLIENT: INTEGRATED WASTE SERVICES			PROJECT: LOW LEVEL CONTAMINATED SOIL CELL
DRAWN: TJM	DATE: 14/10/04	DRAWING CHECK:	DATE:
DESIGNED:	DATE:	DESIGN CHECK:	DATE:
AUTHORISED:	DATE:	SCALE: 1:1000	A3
DRAWING TITLE: CELL 31 INTERIM CAPPING DESIGN PLAN AND DETAILS			
PROJECT No: 04663307	DRAWING No: 3307D04	REVISION: P1	

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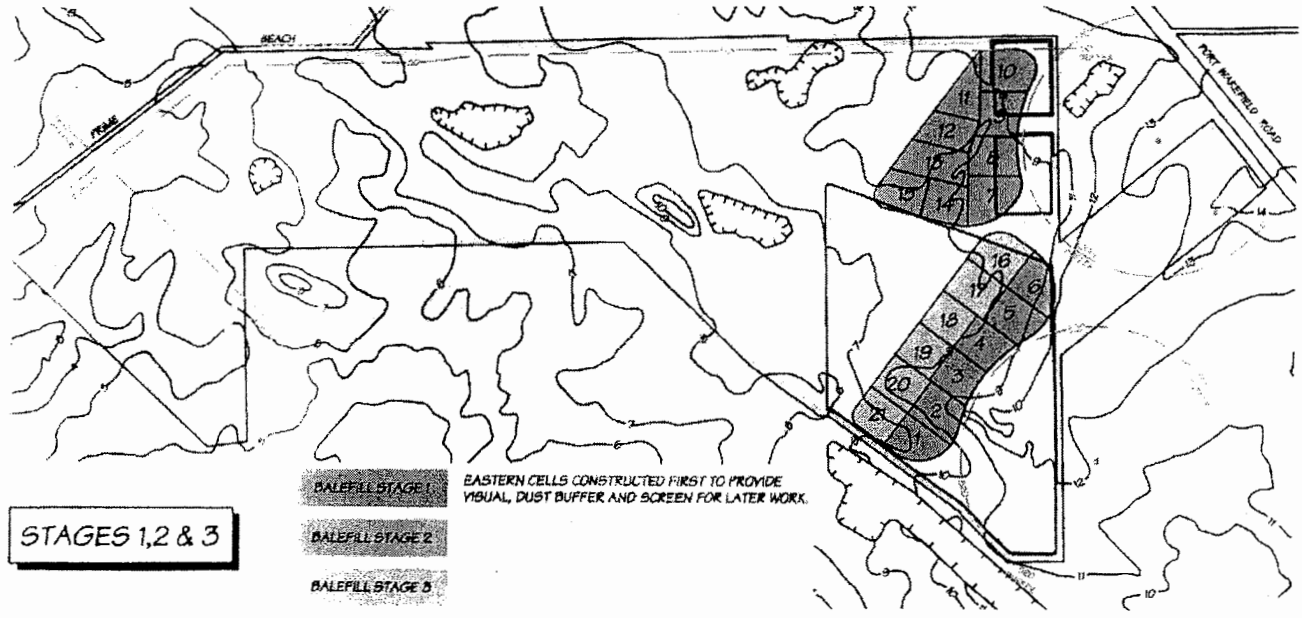

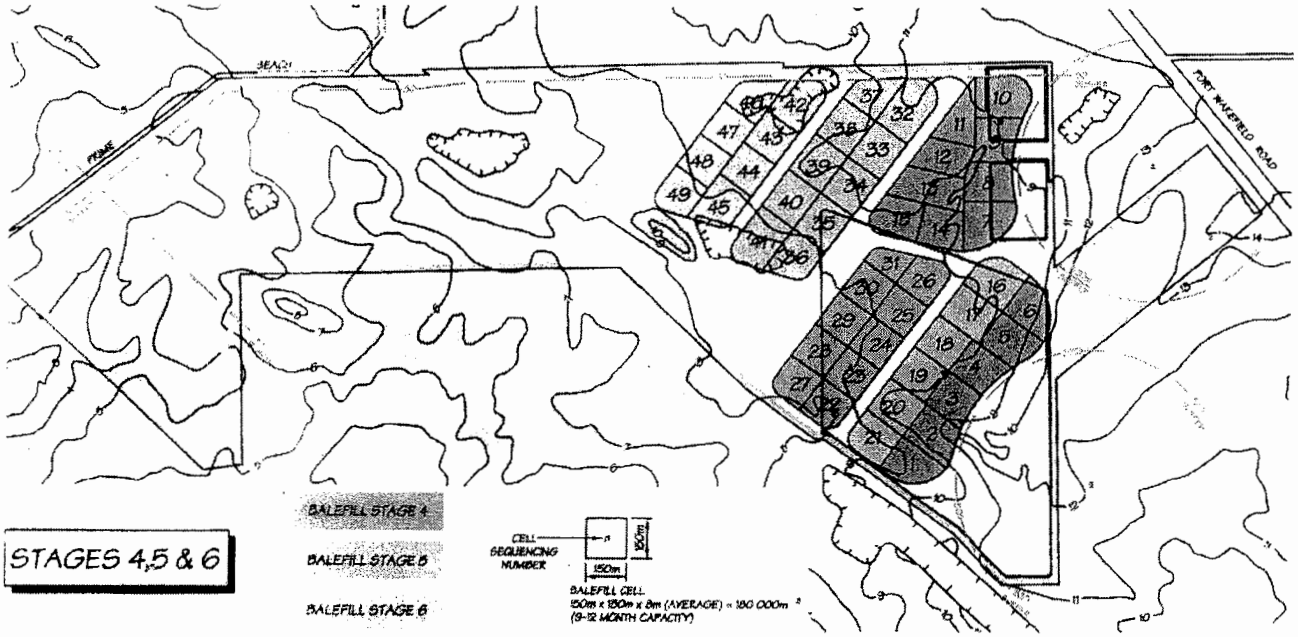

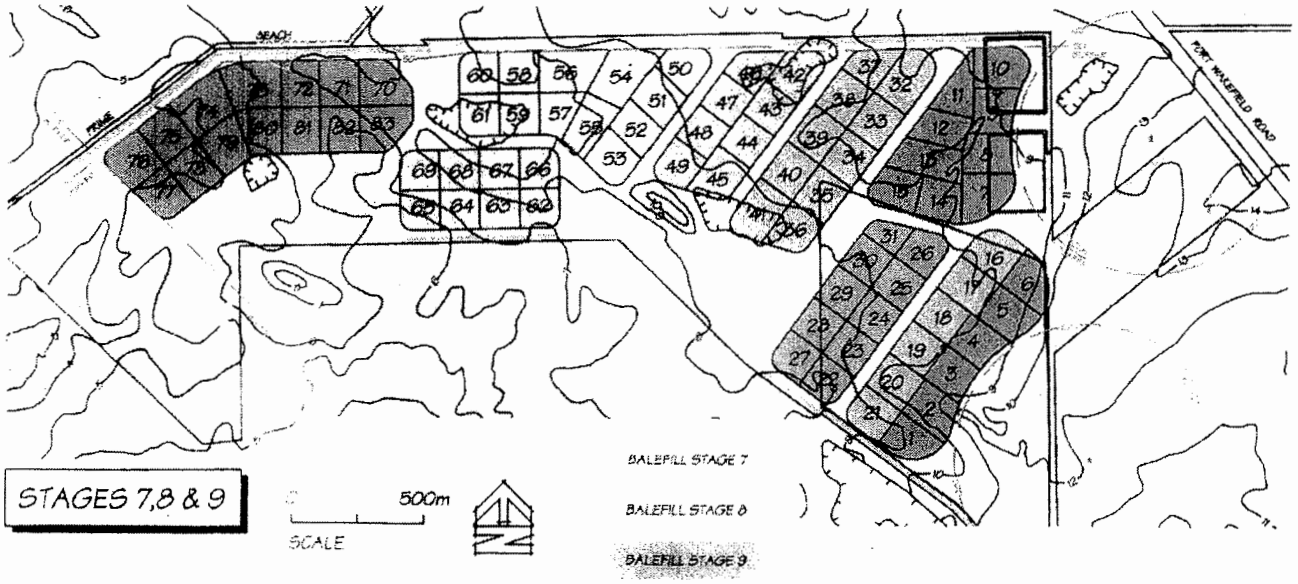

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DRAWN: CRC 13/08/2004		TITLE: LANDFILL STAGING PLAN	
CHECKED:			
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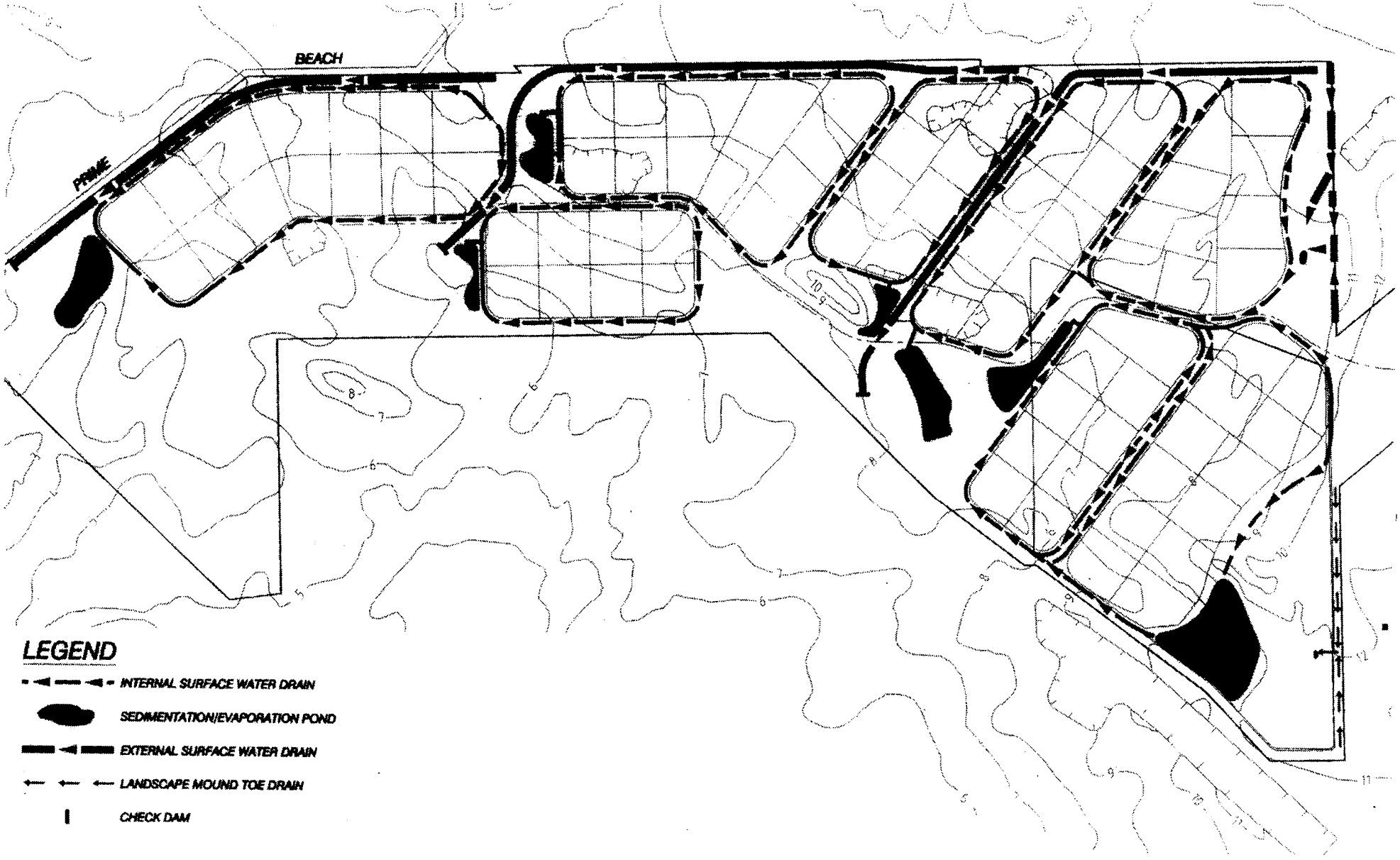

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CLIENT: INTEGRATED WASTE SERVICES		PROJECT: LOW LEVEL CONTAMINATED SOIL CELL	
DRAWN: CRC 13/08/2004		TITLE: FINAL SURFACE WATER CONTROL	
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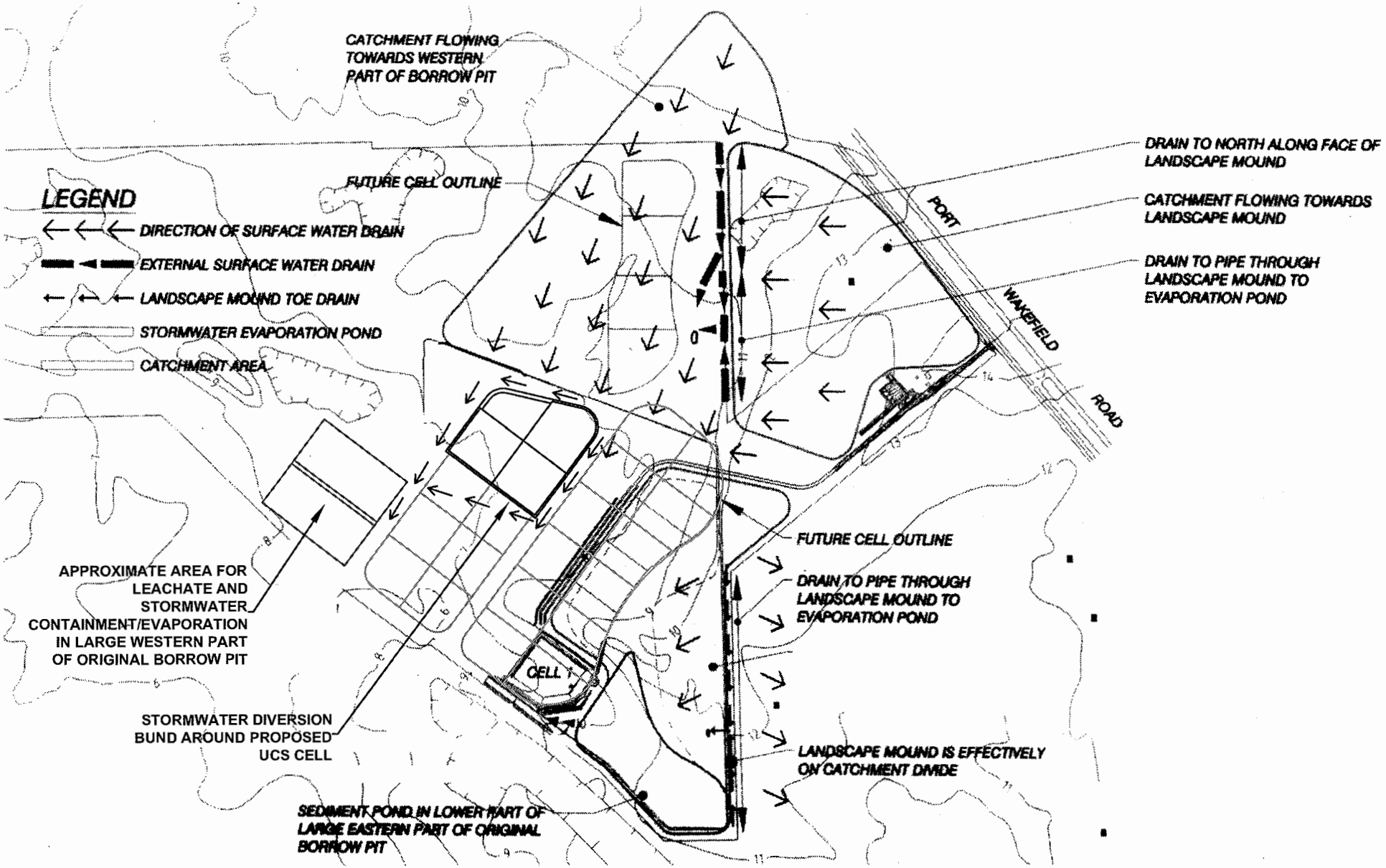

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CLIENT: INTEGRATED WASTE SERVICES		PROJECT: LOW LEVEL CONTAMINATED SOIL CELL	
DRAWN: TJM 27/08/2004		TITLE: INTERIM SURFACE WATER CONTROL	
CHECKED:			
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SUI
DIV
3m

INTERNAL DRAIN

SWALE DRAIN

CELL 30

Natural Runoff
Direction

DIVERSION TO
EVAPORATION
PONDS

CELL 25

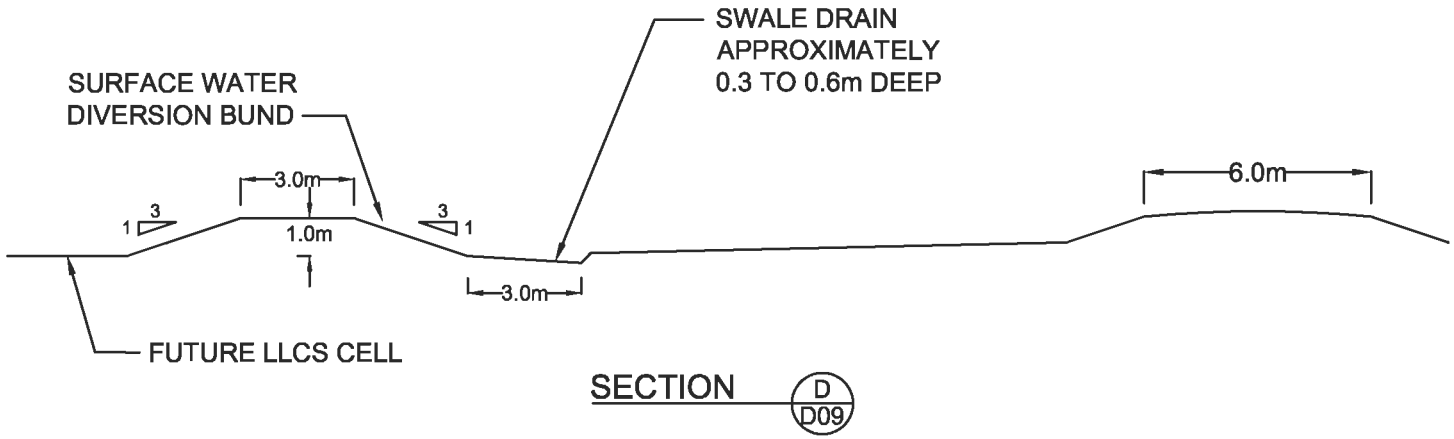
POND 1

CELL 29

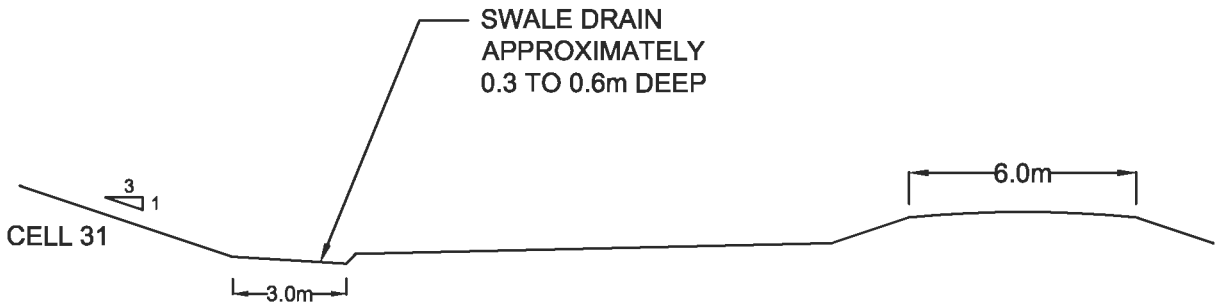
SWALE DRAIN

POND 2

0



SECTION D
D09



SECTION E
D09

0 2 4 6 8 10m

Scale in metres

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CLIENT: INTEGRATED WASTE SERVICES		PROJECT: LOW LEVEL CONTAMINATED SOIL CELL	
DRAWN: CRC 29/08/04		TITLE: SECTIONS D AND E SWALE DRAIN DESIGN	
CHECKED:			
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APPENDIX C

SUBMISSION FROM THE ENVIRONMENT PROTECTION AUTHORITY

EPA 05/10692

Manager
Assessments Branch
Planning SA
Level 5
136 North Terrace
ADELAIDE SA 5001

Dear Sir

AMENDED RESPONSE

RE: IWS DUBLIN, DEVELOPMENT APPLICATION FOR LLCS & LTPR SUPPLEMENTARY INFORMATION FOR EIS AMENDMENT SUBMITTED BY GOLDER ASSOCIATES, DATED 26 NOVEMBER 2004

I refer to an application from Integrated Waste Services Pty Ltd to amend a previously approved Environmental Impact Statement to enable it to receive low-level contaminated soil (LLCS) and liquid Treatment Plant Residues (TPR) at the company's Dublin Balefill site.

It is noted that while the application was made for the installation of four cells (cells 25,26, 30 and 31) for the disposal of LLCS and TPR, detailed designs and specifications were only submitted for cell 31.

This response should be read in conjunction with the:

- Environment Impact Statement (EIS) Amendment Report, Parsons Brinkerhoff (PB), July 2003
- Response Document on the EIS Amendment Report, PB, April 2004
- Golder Associates, November 2004: Supplement Information
- Landfill Environment Management Plan, 2001
- Site drawings
    - 3307DO1, 4/11/2004 - cell 31 design plan
    - 3307DO2, 18/02/2005- section A, liner and sump design
    - 3307DO3, 10/08/2004- liner design sections and details
    - 3307DO4, 14/10/2004- cell 31 interim capping design plan and details
    - 3307DO5, 13/08/2004- landfill staging plan
    - 3307DO6, 13/08/2004- final surface water control

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- 3307DO8, 27/08/2004- interim surface water control
- 3307DO9 P1, 4/11/2004- cell 31 design plan line 2
- 3307D10, 29/08/2004- sections D and E, swale drain design.

Recommendations

The Environment Protection Authority recommends that the amended EIS be approved subject to the following conditions:

Distance to groundwater

1. Based on groundwater level monitoring results and interpolated highest groundwater levels for Cell 31, including a 0.1m buffer, the base of the sump must be at 9.1mAHD.

2. Notwithstanding the above, a minimum separation distance of 2m between the underside of the lowest portion of the lining system and the underlying groundwater must be maintained at all times.

Leachate collection and extraction system:

3. Leachate removal must implement a system which accommodates the installation of the pumps at the leachate riser access point.

4. Following cell completion and until the entire cell base is covered with a minimum of 1.5m of waste, a pump with a flow capacity of a minimum of 40l/s must be installed.

5. After it can be demonstrated that leachate production has declined to less than 1l/s, this pump can be replaced by a pump of lesser flow capacity.

6. A back-up pump with the relevant capacity must be readily available on site at all times.

On page 4, first paragraph of the Golder Associates' Supplementary Information reference is made to run-off calculations from different areas of the cell. It is assumed that approximately 112 cubic metres of run-off will be produced in the *eastern* part of the cell.

Leachate treatment

7. Any leachate generated on site should be managed and treated by means of:

- direct extraction into an on-site leachate evaporation pond which must meet the minimum design specification as follows:
    - composite lining system comprising a 1m low permeability
    - clay liner with $k < 1x\ 10^{-9}$m/s compacted to 95% MDD

Standard between 0 and +4% wet of OMC overlaid by a 2mm HDPE liner (welded)

minimum of 600mm freeboard modelling with HELP or LANDSIM shall consider a 1 in 25, 24h duration storm event

- a minimum separation distance of 2m between the underside of the lowest portion of the lining system and the underlying groundwater must be maintained at all times

- direct extraction into an onsite tank vehicle suitable for the transport of leachate into an onsite leachate evaporation pond
- direct extraction into a licensed vehicle and transported to an off-site licensed Waste Water Treatment Plant
- direct extraction into a suitably designed, temporary on-site storage tank prior to off-site disposal by a licence vehicle into a licensed Waste Water Treatment Plant or prior to on-site transport into a leachate evaporation pond.

Leachate management

8. A maximum leachate head of 300mm needs to be maintained on top of the liner (excluding the sump) at all times. To facilitate this the trigger level for leachate extraction out of the leachate sump needs to be set at 290mm.

9. In addition to automatic leachate data readings a manual monitoring probe needs to be installed and calibrated to allow for direct readings of the vertical elevation of leachate in the riser pipe and conversion to the maximum leachate head on top of the liner.

10. Leachate levels must be read manually daily and recorded in the on-site operations logbook or as specified otherwise in the EPA licence.

Distance between LLCS/TPR Cell and Balefill cell (reference drawing 3307D03)

11. The distance between LLCS/TPR and Balefill cells must be at a minimum of 5m, measured between the toe of the LLCS cell structure (that is where the outer surface of the cap of the completed LLCS/TPR cell joins the outer surface of the underlying clay liner for the same cell) and the cap of the nearest balefill cell (that is where the outer surface of the cap of a completed balefill cell joins the outer surface of the underlying clay liner).

Level 1 Supervision

12. The construction of the clay liner of the cell shall be carried out under Level 1 Supervision in accordance with AS 3798-1996, Appendix B.

13. The construction of the HDPE liner shall be carried out under the full time supervision of a suitably qualified geotechnical consultant with experience in the construction and supervision of the construction of HDPE lining systems, quality control procedures and testing.

"As Constructed Report"

14. An "As Constructed Report" certifying compliance with the approved design for the lining system, including an Construction Quality Assurance Report (CQA) for the HDPE liner and the L1SA report, must be submitted to the EPA for acceptance prior to the commencement of receival and disposal of waste in the cell. No waste shall be received and disposed of prior to written acceptance of the "As Constructed Report" by the EPA.

Coverage of waste

15. All waste must be covered as soon as reasonable practicable after the receipt of waste and placement in the cell or at close of business on each business day with at least 150mm of cover material (waste fill or intermediate landfill cover with the restriction to a maximum particle size of 100mm).

16. Should a load of particularly odorous material be received at a LLCS/TPR cell, it must be covered immediately with a minimum of 150mm cover material.

17. During periods when the LLCS/TPR cell is not operating, routine monitoring for odorous gases must be carried out as part of the site monitoring program and may trigger the application of additional cover material.

Note: Alternative cover materials can be used after the licensee:

- has demonstrated that the proposed material and placement method do result in an equivalent or better performance compared to the approved material, and

  and has received written approval from the Authority prior to the use of alternative materials and placement methods.

Groundwater management

18. An additional groundwater well must be installed west of cell 30 and the first round of groundwater sampling and testing must be completed at least 2 weeks prior to commencement of construction of cell 31.

19. Groundwater level monitoring must commence at least 2 weeks before commencement of construction of cell 31; groundwater levels must be taken weekly and reported to the EPA monthly (datasheet and graph) or as specified otherwise in the EPA licence.

20. Four monitoring rounds at three monthly intervals in the first 12 months of operation must be carried out to establish additional background analyte levels around cell 31.

21. Six monthly monitoring rounds must be undertaken following the completion of the initial 12 months of groundwater monitoring or as specified otherwise in the EPA licence.

22. Prior to the commencement of construction of any other cell for the receipt of LLCS &TPR, the groundwater management and monitoring program must be reviewed and submitted for EPA's approval.

Surface Water Management

23. A stormwater management plan must be developed and submitted for EPA's approval addressing all issues related to the staged construction of LLCS/TPR cells on site prior to commencement of construction of cell 31.

Note: The stormwater management plan must provide surface water control and management measures for:

- surface water or stormwater runoff that does not interact with the waste material or other operational areas of the site and is considered to be uncontaminated

  surface water that comes into contact with waste materials or is collected from landfill areas or other operational areas and is considered to be contaminated
- surface runoff from the final landfill cap which has to be controlled
- surface water runoff from perimeter areas must be diverted from the operating cell.

Landfill Environment Management Plan (LEMP)

24. The new section of the LEMP ('Section 17') must be completed following the development approval and incorporated in the revised LEMP document.

25. The complete revised LEMP document must be finalised and submitted to the EPA for approval prior to the receipt and disposal of LLCS and TPR on the premises.

For further information please contact Marina Wagner, Principal Adviser, Waste Management, EPA, telephone 82042339

Yours sincerely,

Peter Torr
Delegate
ENVIRONMENT PROTECTION AUTHORITY

Date: 3 March 2005