PUBLIC ENVIRONMENTAL REVIEW

REDEVELOPMENT OF THE

SWAN PORTLAND CEMENT SITE

BURSWOOD

October 1996

CMPS&F

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A	8/7/96	Draft Issued to Swan Portland	NG	NJC/SAB	
B	18/7/96	Draft Issued to DEP	NJC	SAB	
0	16/10/96	Final Issue	SAB		

INVITATION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

The document describes a proposal by Swan Portland Cement Limited to decommission the existing cement works in Burswood and remediate areas of the site which have been filled with residual wastes that may compromise future use of the site. In accordance with the Environmental Protection Act, the document has been prepared to describe this proposal and its likely effects on the environment. The document is available for a public review period of four weeks from 21 October 1996, closing on 18 November 1996.

Comments from government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to the Minister for the Environment.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in each report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If you group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the document or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the document:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that the issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the document;
- if you discuss different sections of the document, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submission is 18 November 1996.

Submissions should be addressed to:

The Chairman
Environmental Protection Authority
Westralia Square
141 St Georges Terrace
PERTH WA 6000

Attention: Mr Henk Van Der Wiele

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Prep By	JVR	18/6/96
Chk By	NC	18/6/96
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Site Locality

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EXECUTIVE SUMMARY

This Public Environmental Review (PER) describes a proposal by Swan Portland Cement Limited to redevelop its Burswood cement manufacturing site for a range of commercial and residential purposes. The site contains waste materials that are the legacy of its previous use as an industrial site. Detailed investigations have identified waste materials, including asbestos, kiln bricks and lubricating oil that could compromise the future development of the site.

Asbestos was originally known to occur on the Swan Portland site in two main forms, above the ground in the form of asbestos cement sheeting and below the ground where asbestos remnants, off-cuts and other wastes have been buried on-site. It is proposed that all material known to contain asbestos will be excavated from the site and disposed of to landfill.

Other wastes which were buried on site include alumina and chromate bricks, which were originally used to line the rotary kilns in Swan Portland's plant. Although the kiln bricks can produce a chromate bearing leachate, no contamination has been found. The proponent proposes to remove them from the site and dispose of them to landfill.

The other material which will be removed from site is soil and drums containing lubricating oils. Old fuel storage tanks which remain on site will be decommissioned, while buried oil drums which contain lubricating oils will be excavated and treated by bioremediation.

Water quality investigations at the Swan Portland site have found ground and surface waters to be alkaline. This has been attributed to the cement kiln dust which has been deposited over much of the site. This dust is inert, however it does contain lime which reacts with water causing it to become alkaline.

Redevelopment of the site will help the alkalinity of these waters. Groundwater under the site is currently elevated because of water discharges from the plant which infiltrate the cement kiln dust. Once process waters are no longer discharged and other surface waters are managed, the watertable will fall. As a result, leaching of the cement kiln dust will be reduced, and the alkalinity of the groundwater will decrease.

The proponent, Swan Portland, considers that this proposal will have a positive impact on the environment by appropriately disposing or treating material that could compromise the future use of the site. This will allow the development of the site for uses that are appropriate for an inner city location. The environmental management proposed in this document will ensure that these works will be carried out safely and with no significant impact to the environment. Table 1 summarises the proposed environmental commitments for the project.

TABLE 1 - LIST OF ENVIRONMENTAL COMMITMENTS

PRE-IMPLEMENTATION

Category	Topic	Present State/ Potential Impacts (Refer to Section)	Objectives	Proposed Management Commitments	Key Agency *
Pollution Potential	Asbestos Dust	3.1	• To comply with occupational exposure standards and minimise the risk to workers on-site and members of the public.	• An air monitoring programme will be performed before asbestos works. • Details of the monitoring programme will be included in the works programme forwarded to Worksafe WA and the Department of Environmental Protection (DEP) prior to commencement of works	DEP Worksafe WA Health Dept
Waste Management	Destination of Waste Materials	Asbestos - 3.1 Cement Kiln Dust - 3.2 Kiln Bricks - 3.3 Buried Oil Drums - 3.4 Fuel Storage Tanks - 3.5	• To ensure that all waste from site is managed or disposed in a manner which reduces environmental impact and risk to humans	• The ultimate destination of all waste material will be selected on the basis of criteria set by the Division of Waste Management of the DEP. • The proponent will consult with the DEP during the selection process.	DEP DEP

IMPLEMENTATION

Category	Topic	Present State/ Potential Impacts (Refer to Section)	Objectives	Proposed Management Commitments	Key Agency *
Pollution Potential and Management	Asbestos	2.1, 3.1	• To ensure removal of asbestos from the site to landfill complies with relevant regulations.	• Remove all asbestos in accordance with the Code of Practice for the Safe Removal of Asbestos and management techniques described in the PER. • Liaise with Worksafe WA in preparing a works programme for this work.	Worksafe WA Health Dept Worksafe WA
Pollution Potential	Asbestos Dust	2.1, 3.1	• To minimise asbestos dust produced during removal of ACM.	• An air monitoring programme will be performed during asbestos works.	DEP Worksafe WA Health Dept

Category	Topic	Present State/ Potential Impacts (Refer to Section)	Objectives	Proposed Management Commitments	Key Agency *
Waste Management	Transportation	1.1, 3.3, 4.2, 4.3.2, 4.5, 4.6, 4.10.1	• To minimise the risk of transporting waste materials from the site.	• All materials transported from the site will be carried in appropriately equipped and labelled trucks in a manner consistent with the relevant codes that relate to the transport of the material.	Worksafe WA DEP Health Dept
Pollution Potential	Waste, Dust and Noise Discharges	Water: 2.1, 2.2.3 Dust: 3.2, 4.3.3 Noise: 4.10.4	• To ensure that water, dust and noise discharges during implementation of the project comply with statutory requirements and appropriate criteria.	• Water, dust and noise discharges from the site will be kept within the relevant criteria set by the DEP during the implementation phase of the project. • The proponent will monitor discharges from the site to confirm that the criteria are met. • Breaches of criteria will be reported to the Swan River Trust or the DEP.	DEP DEP, SRT DEP, SRT
Waste Management	Cement Kiln Dust	3.2	• To manage the CKD on-site.	• Areas of the site containing CKD will have a cover of at least 0.5 m of fill material. This will be done as part of the recontouring of the site to enable construction to commence	DEP
Pollution Potential	Stormwaters	2.1, 2.2.3	• Minimise the environmental impacts of stormwater leaving the site.	• All stormwater generated from the site will be collected and piped to the Swan River via a reticulated system. This will be done as part of the construction phase of the project.	DEP Water and Rivers SRT
Pollution Potential	Groundwater Quality & Watertable Levels	2.2.4, 3.6	• To ensure the groundwater quality achieved is consistent with the predictions made in the PER.	• Groundwater quality and watertable levels be monitored during works. • Results of the monitoring will be reported to the DEP upon completion of works.	DEP Water and Rivers DEP

Category	Topic	Present State/ Potential Impacts (Refer to Section)	Objectives	Proposed Management Commitments	Key Agency *
Conformance	Performance Review	7.0, Commitment 9	• To ensure the conditions of approval for the project are achieved.	• A suitably qualified organisation will be retained by the proponent as an independent third party to advise on the success of the decommissioning in meeting the conditions of approval for this project. • Personnel from this organisation will check by monitoring, or any other method appropriate, conformance to these conditions	DEP Worksafe WA
Conformance	Project Report	4.1, 4.3.3, 4.8	• To document the project at the site upon completion of the implementation phase.	• A report will be prepared at the completion of the decommissioning (implementation phase) which will provide evidence of conformance to the commitments and ministerial conditions set for the project. • The report will be provided to the DEP and the Swan River Trust.	DEP, SRT DEP, SRT

POST-IMPLEMENTATION

Category	Topic	Present State/ Potential Impacts (Refer to Section)	Objectives	Proposed Management Commitments	Key Agency *
Pollution Potential	Asbestos Dust	2.1, 3.1	• To ensure the removal of ACM was successful.	• The air monitoring programme which is conducted during implementation, will be continued after works to monitor asbestos dust.	DEP Worksafe WA Health Dept
Pollution Potential	Groundwater quality and watertable levels	2.2.4, 3.6	• To ensure the groundwater and watertable achieve the predictions of the PER.	• Groundwater quality and watertable levels will be monitored after works to confirm the predictions described in the PER.	DEP SRT Water and Rivers

Category	Topic	Present State/ Potential Impacts (Refer to Section)	Objectives	Proposed Management Commitments	Key Agency *
Conformance	Project Report	4.3.2, 4.8	• To document the post implementation monitoring at the site.	• A report will be periodically produced during post implementation monitoring of asbestos dust. This report will be provided to the DEP. • Results of groundwater quality and watertable levels will be reported to the DEP during the post implementation phase.	DEP Health Dept DEP

* Agency Summary:
DEP - Department of Environmental Protection
Worksafe WA
SRT - Swan River Trust
Water and Rivers Commission
Health Department

SECTION 1
INTRODUCTION

1.1 INTRODUCTION

This Public Environmental Review (PER) describes a proposal by Swan Portland Cement Limited to redevelop its Burswood cement manufacturing site for a range of commercial and residential purposes. The PER has been designed to meet the requirements of the Environmental Protection Authority. It addresses the demolition of the cement making buildings and the removal of various residual wastes known to be on the site.

The proponent Swan Portland Cement Limited referred the project to the EPA in July of 1996. The EPA requested the proponent to prepare the PER in order to provide information about the project to the general public and to assist the EPA in the preparation of an Assessment Report for the Minister for the Environment. The public is encouraged to provide written comment to the EPA as part of the environmental review process during the nominated public review period. The assessment process is described in more detail in Section 1.5.

The Burswood site is currently occupied by Swan Portland's cement manufacturing plant, associated infrastructure and materials storage areas. The site also encompasses an area formerly used by James Hardie Industries to manufacture asbestos products. This area of land was purchased by Swan Portland from James Hardie Industries after the closure of the asbestos products plant in 1981.

The Swan Portland site is located approximately 4 km east of the Central Business District of Perth (Figure 1). The site is bounded to the east by the Perth to Bunbury railway line and Goodwood Parade and to the south and west by the Burswood Resort Complex. Land to the north of the site is owned by the Western Australian Government. It houses the new Tennis West Centre and club house of the Burswood Golf Club.

The Burswood Peninsula has undergone significant redevelopment over the last decade and this redevelopment proposal is designed to increase the compatibility of the Swan Portland site with surrounding land uses. This is of particular relevance because of the unique location of the site with respect to the City of Perth.

Detailed investigations have identified waste materials that are the legacy of the site's previous use. The wastes which could compromise the future development include asbestos containing material located near the former James Hardie site, kiln bricks and drums containing waste lubricating oils. It is proposed that these materials be removed. The site will then be prepared for future commercial and residential development.

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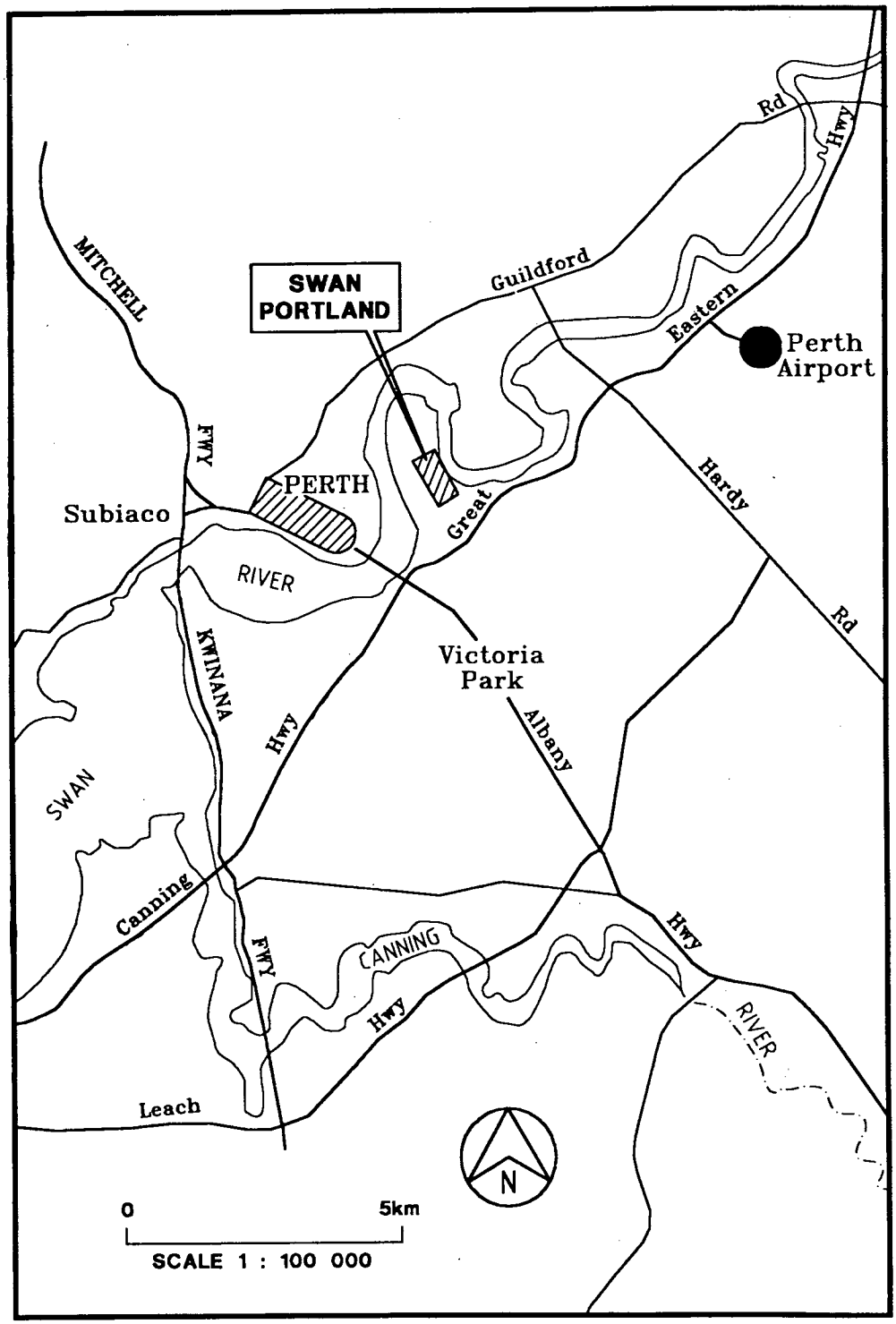
LOCATION OF SWAN PORTLAND

FIGURE 1



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1.2 OBJECTIVES OF THE PER

The PER has been prepared in accordance with the guidelines issued by the EPA (Appendix A) with the following objectives:

- to place this proposal in the context of the local and regional environment;
- to explain the issues, decisions and feasibility alternatives which led to the choice of this proposal at this place and at this time;
- to set out the specific environmental impacts that the proposal may have; and
- for each impact, to describe how the proponent would avoid, mitigate or ameliorate that impact.

1.3 THE PROPONENT

The proponent is Swan Portland Cement Ltd, an unlisted company owned by Adelaide Brighton Ltd, CSR and Pioneer International.

Swan Portland Cement is a 70 year old Western Australian company currently based in Perth next to the Burswood Casino site on the Swan River. Swan has been engaged in the manufacture of cement, lime and associated products at its Burswood site since 1927.

The company is planning new clinker grinding and lime manufacturing facilities at Kwinana, south of Perth, thus enabling the closure of the Burswood operation.

1.4 LEGISLATIVE REQUIREMENTS

Relevant legislation and its application to the proposed project are briefly outlined as follows:

- The Environmental Protection Act, 1986 requires that the proponent prepare documentation of the proposal for evaluation through the environmental approval process, and provides powers for the prevention, control and abatement of discharges into and polluting of, the environment.

- The Town Planning and Development Act, 1928 empowers the Town of Victoria Park to control development under the provisions of its Town Planning Scheme.

- The Local Government Act, 1960 provides authority to the Town of Victoria Park with respect to local planning and zoning regulations.

- The Occupational Safety and Health Act, 1984 provides regulations to ensure the health, safety and welfare of the workforce, together with the safety of the general public when on site.

- The Rights in Water and Irrigation Act, 1914 provides for the issuing of licences for bores and other activities that may affect groundwater or surface water resources.

- The Heritage of Western Australia Act, 1990 provides regulations to conserve the cultural heritage and facilitate development that is in harmony with cultural heritage values.

1.5 ASSESSMENT PROCESS

The EPA can require a report for any development proposal in Western Australia which can be in the form of a Consultative Environmental Review (CER), Public Environmental Review (PER) or Environmental Review and Management Programme (ERMP). These documents are intended for distribution to the public for review and comment and are required to provide information on environmental implications of the proposal and procedures for environmental management and monitoring.

The Environmental Impact Assessment (EIA) approval process is illustrated in Figure 2.

The public review process commences with EPA approval for the release of the PER for review. Written submissions from individuals, groups and government departments can be made to the EPA during the four week review period.

The proponent is given an opportunity to respond to the points raised in the submissions and these responses are then incorporated into the EPA assessment of the proposal. Subsequently the EPA recommends to the Minister for the Environment that the project is either:

- environmentally acceptable
- acceptable subject to certain conditions; or
- environmentally unacceptable

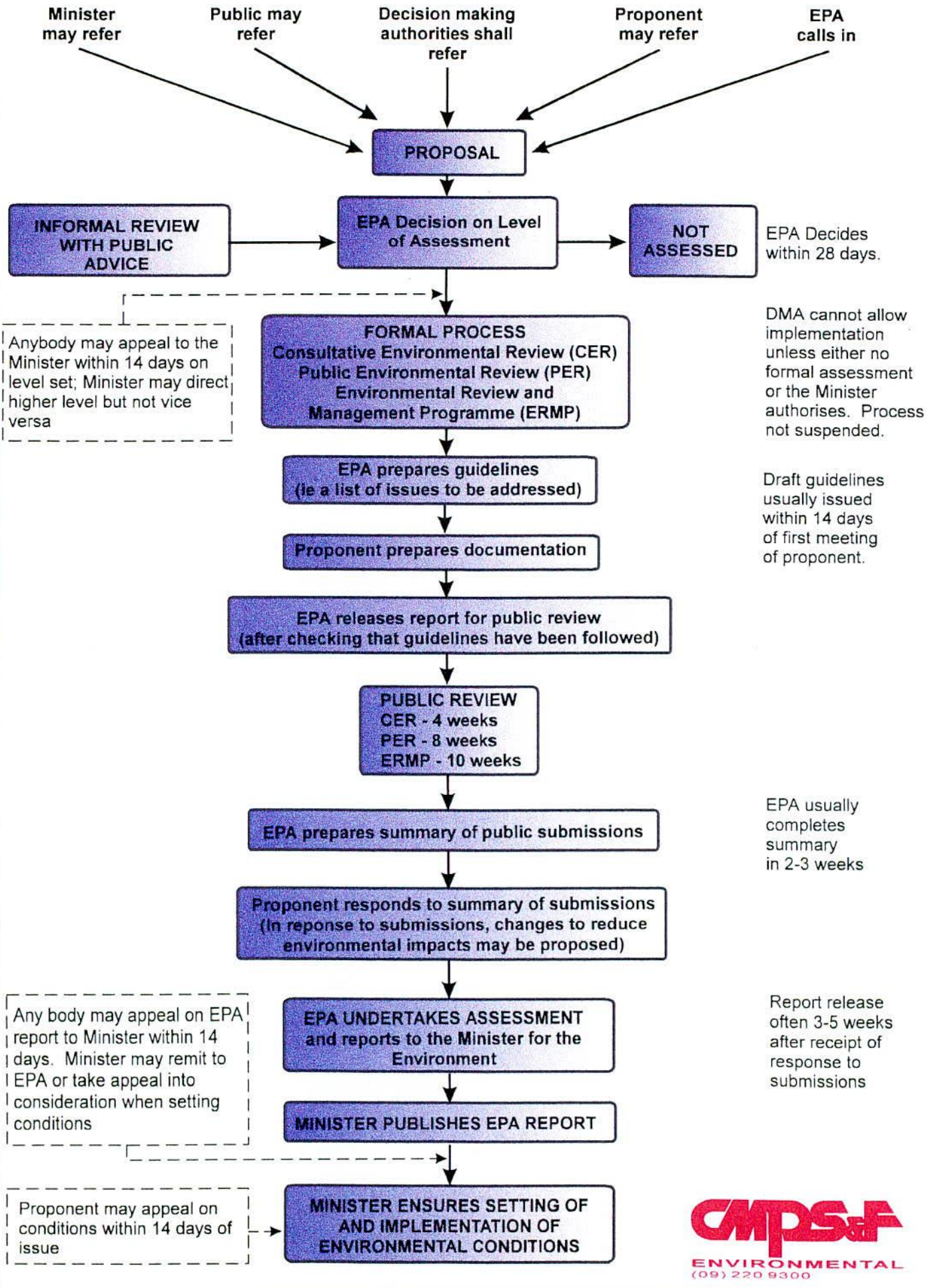
Having received advice from the EPA the Minister then decides whether to give approval for the project to proceed.

1.6 DEVELOPMENT PROPOSAL

Plans for the future use of the site are currently under development. The area is presently zoned "urban" under the Metropolitan Regional Scheme with a classification of "Residential R60" under the local town planning scheme. This classification permits medium density residential unit development at the rate of 60 units per hectare. Swan Portland is currently seeking to rezone the site from its present "Residential R60" zoning to a "Special Use" designation which would include:

- Tourism/Recreation - this could include hotels and associated leisure facilities

FIGURE 2 - EIA PROCESS FLOW CHART



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- Residential Development - involving a change in classification to an R80 zoning (80 residential units per hectare) and possibly as high as R160 (160 units per hectare)
- Office/Residential Development
- Special Commercial - this would include office park or technology park type uses, as well as retail

A copy of the proposed Swan Portland Development - Burswood Peninsula Precinct Plan is shown in Figure 3.

1.7 TIMING OF THE PROPOSAL

It is anticipated that the Swan Portland site will close its two clinker kilns in December 1996 and the site will close completely midway through 1997. It is however possible that the lime kiln will continue to operate on site until August 1997. It is proposed that site clean-up will commence at some time between June and August 1997 and continue for a period of about 20 weeks.

SECTION 2
THE SITE

2.1 HISTORICAL OVERVIEW

The following section is a brief account of the history of the Swan Portland site and the production processes of cement manufacturing. The information provides a very good indication of the location and nature of waste materials.

The Swan Portland site is part of the Burswood Peninsula which has undergone significant modification over the last century. Plans dating back to 1888 indicate that the course of the river has changed over time and the swampy land of the peninsula has been gradually filled. At the time of construction of the cement works in 1920 a canal trafficable by marine craft was in operation.

After the cement works began operating, a skipway was constructed which transported calcite shell material dredged from the river, to the cement works. An aerial photograph taken in 1948 (Figure 4) indicates that the canal and skipway were still in use at this time.

The manufacturing process at Swan Portland is simple and involves basic raw products (Figure 5). The process involves the crushing and milling of limestone and the addition of small amounts of bauxite and clay with water to form a slurry. This slurry is fed to long rotary kilns where it is dried and heated up to 1,450°C. Under these conditions the calcium carbonate in the limestone is converted to calcium oxide which in turn reacts with silica, alumina and iron oxide from the various ingredients to form complex calcium silicates and aluminates. The product leaving the kiln (clinker) is then mixed with a small amount of natural gypsum and milled to a very fine powder to form the final product, Portland Cement.

Another process involves heating limestone to 1,050°C to form calcium oxide, more commonly called quicklime. Quicklime is either sold or further processed to hydrated lime.

Clay on-site was excavated for use by the cement works. A large open clay pit was created as a consequence of this mining, however this has been progressively filled (Figures 6 and 7). By 1987 a southern holding dam, car park and clinker shed had also been constructed (Figure 8). Photographic evidence indicates that cement kiln dust (CKD) has been disposed over much of the site. Alkaline stormwaters and process waters were also disposed over the northern sections of the site.

Originally stormwater runoff and wastewater from the plant were discharged to the clay pit lagoon. The majority of water now flows to a water storage trench adjacent to the lagoon. The on-site lagoons are known to leak, therefore both historically and at present these lagoons create a subsurface flow of water to the two drains on the western perimeter of the site.

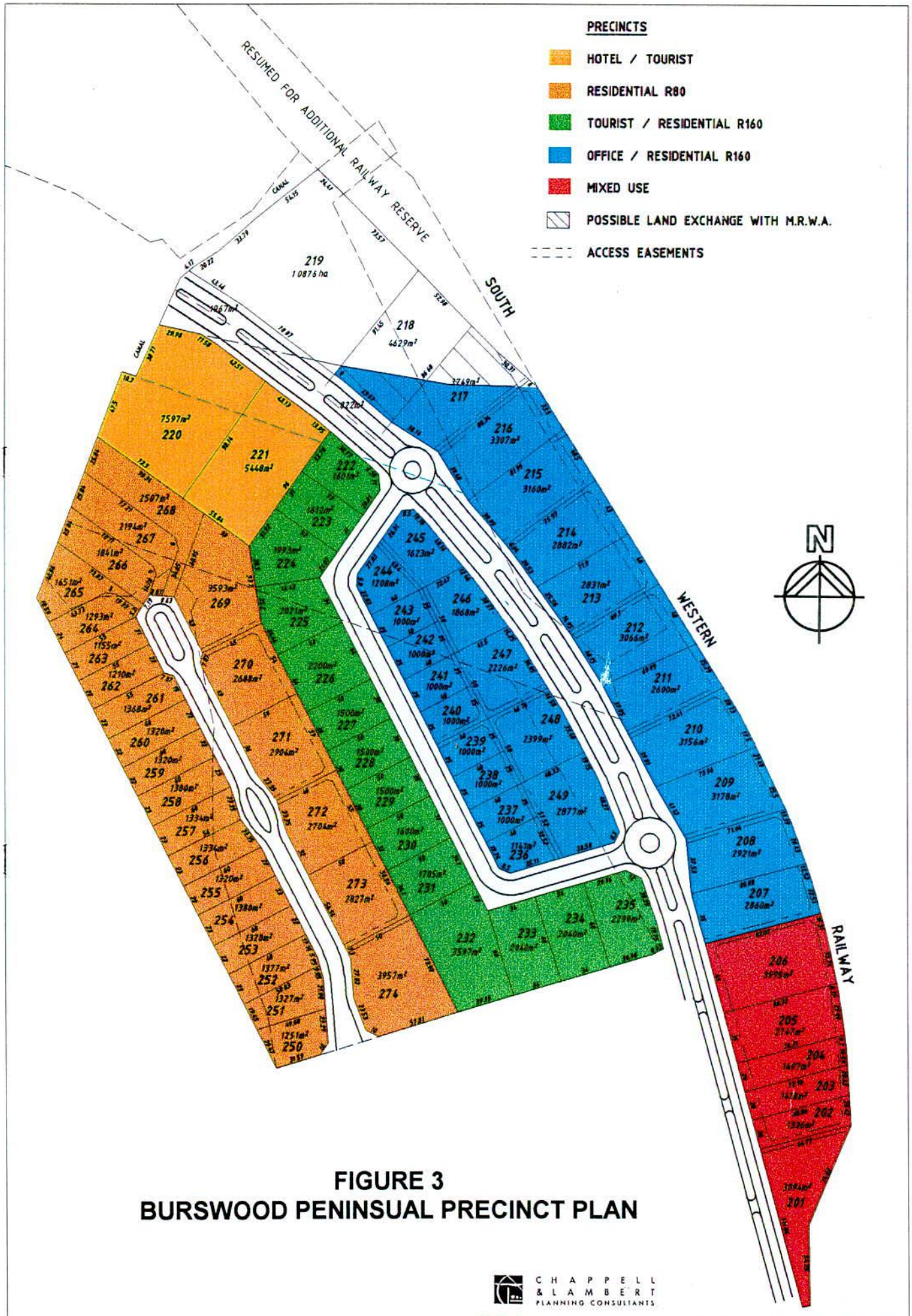
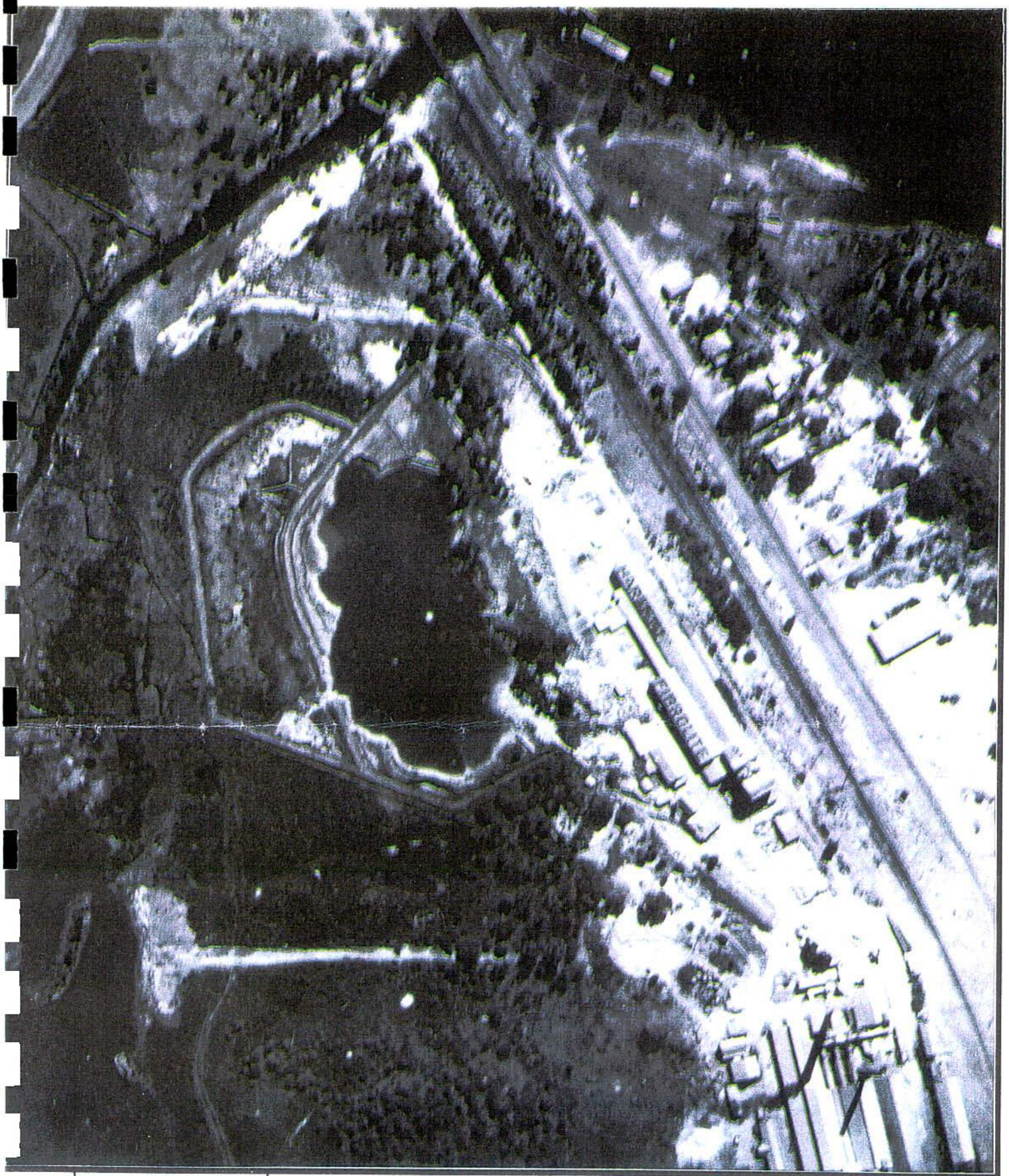


FIGURE 3
BURSWOOD PENINSUAL PRECINCT PLAN

CHAPPELL & LAMBERT PLANNING CONSULTANTS

McMULLEN NOLAN AND PARTNERS SURVEYORS PTY LTD



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SWAN PORTLAND CEMENT MANUFACTURING PLANT -1948-

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FIGURE 4

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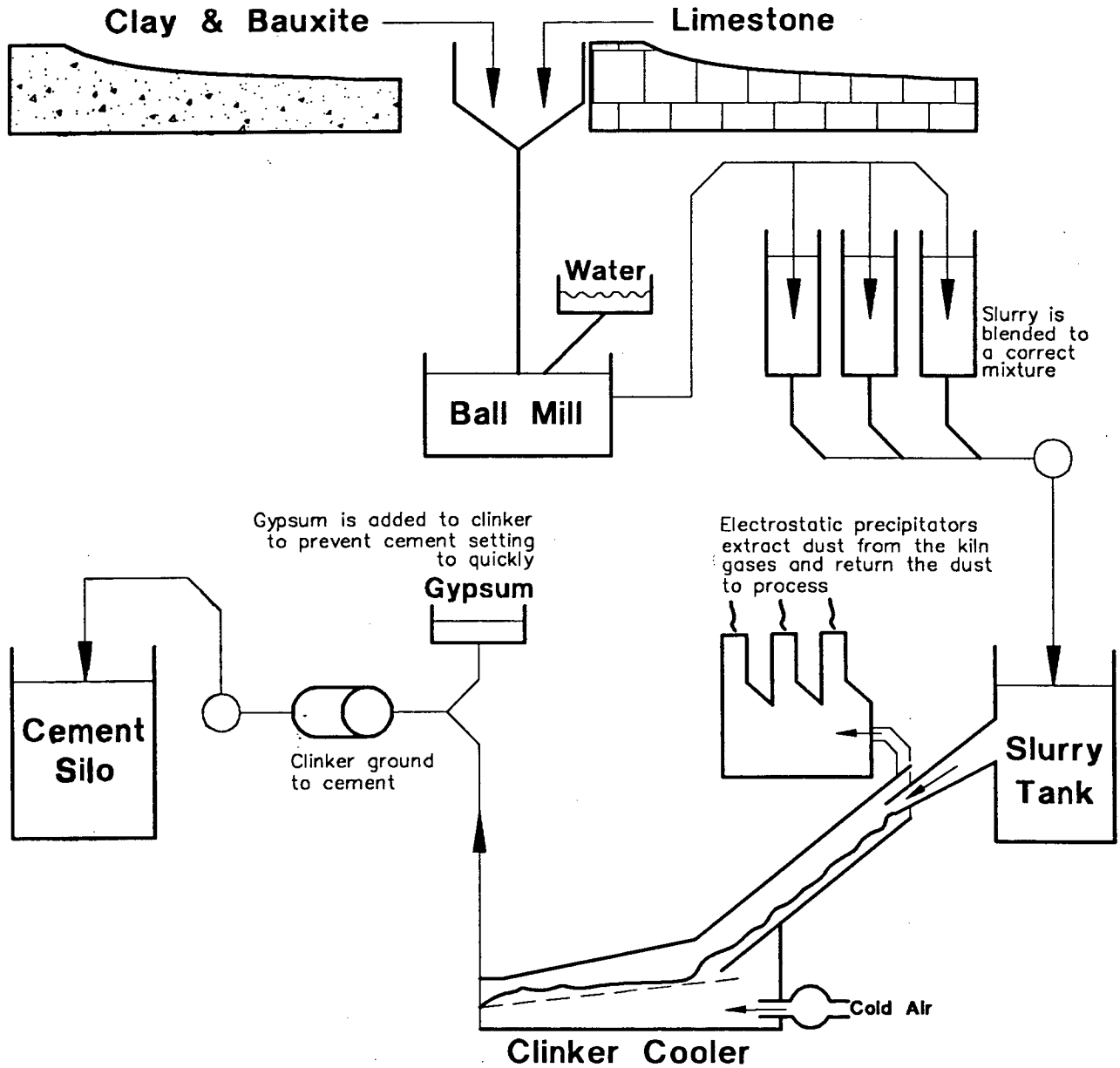
FIGURE 5

SWAN PORTLAND CEMENT PRODUCTION PROCESS



WET PROCESS

Water is added to the chalk as it is ground then clay is added to form a slurry. The slurry is mixed and blended to the correct chemical composition and is pumped to a rotary kiln. In the kiln the water is boiled off. Curtain chains hung up in the kiln control the flow of liquid slurry down the kiln. The chains also lift the slurry into the hot gas stream and promote heat exchange.

The raw material leave the chains as small nodules. As they travel down the kiln they hotter and hotter and carbon dioxide is driven off. Finally the raw materiall is converted to clinker in the burning zone. By now it has reached a temperature of 1450°C and is white hot. The clinker is cooled by blowing cold air through it and the air is so heated is then used in the kiln.

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SWAN PORTLAND CEMENT MANUFACTURING PLANT -1959-

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FIGURE 6

Original Dimensions of claypit

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The sources of water feeding into the trench and lagoon included:

- process waters from the plant
- stormwater drainage
- surface run-off
- direct rainfall

The discharge of highly alkaline water from the lime plant was discontinued in 1995.

An asbestos factory owned by James Hardie Industries Pty Ltd was established and located adjacent to the northern boundary of Swan Portland Cement. Figures 4, 6 and 7 show the development of the site from 1948 to its closure in 1981. Asbestos waste was deposited over the James Hardie site, extending onto the Swan Portland site. Asbestos containing material (ACM) on the Swan Portland site was washed into the lagoons adjacent to the built up fill areas. Following the closure of James Hardie's asbestos factory, the site was acquired by Swan Portland.

The present site layout is shown in Figure 9.

2.2 PHYSICAL ENVIRONMENT

2.2.1 Geology

Much of the local geology of Burswood Island belong to late Tertiary and Quaternary Formations and have been described as 'Superficial Formations'. These formations can be laterally and vertically variable sequences of sediments comprising:

- Recent alluvial deposits associated with the current course of the Swan River. It is in this zone that the past landuse practices have modified the strata to the condition where now a mosaic of soils and sediments predominate over the entire site.
- Below depths ranging from 10 to 20 m, the alluvial deposits give way to the clayey sands and sandy clays of the Guildford Formation.

The Guildford Formation is underlain by the late Cretaceous Osborne Formation, which comprises glauconitic shale, siltstone and sand. A geological map of the area around Burswood is presented in Figure 10.

2.2.2 Topography

The highest points within the site, approximately 10m AHD (Australian Height Datum), occur on the eastern side of the cement works. Generally the fall of the land is westwards with the raw products storage area being the low point of the site at approximately 1-2 AHD (Ove Arup and Partners, 1993). Surface elevation over the Peninsula has generally increased due to the placement of fill material throughout most of the site.

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SWAN PORTLAND CEMENT MANUFACTURING PLANT -1981-

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FIGURE 7

Partially infilled claypit

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Approx. Scale

SWAN PORTLAND CEMENT MANUFACTURING PLANT
-1987-

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FIGURE 8

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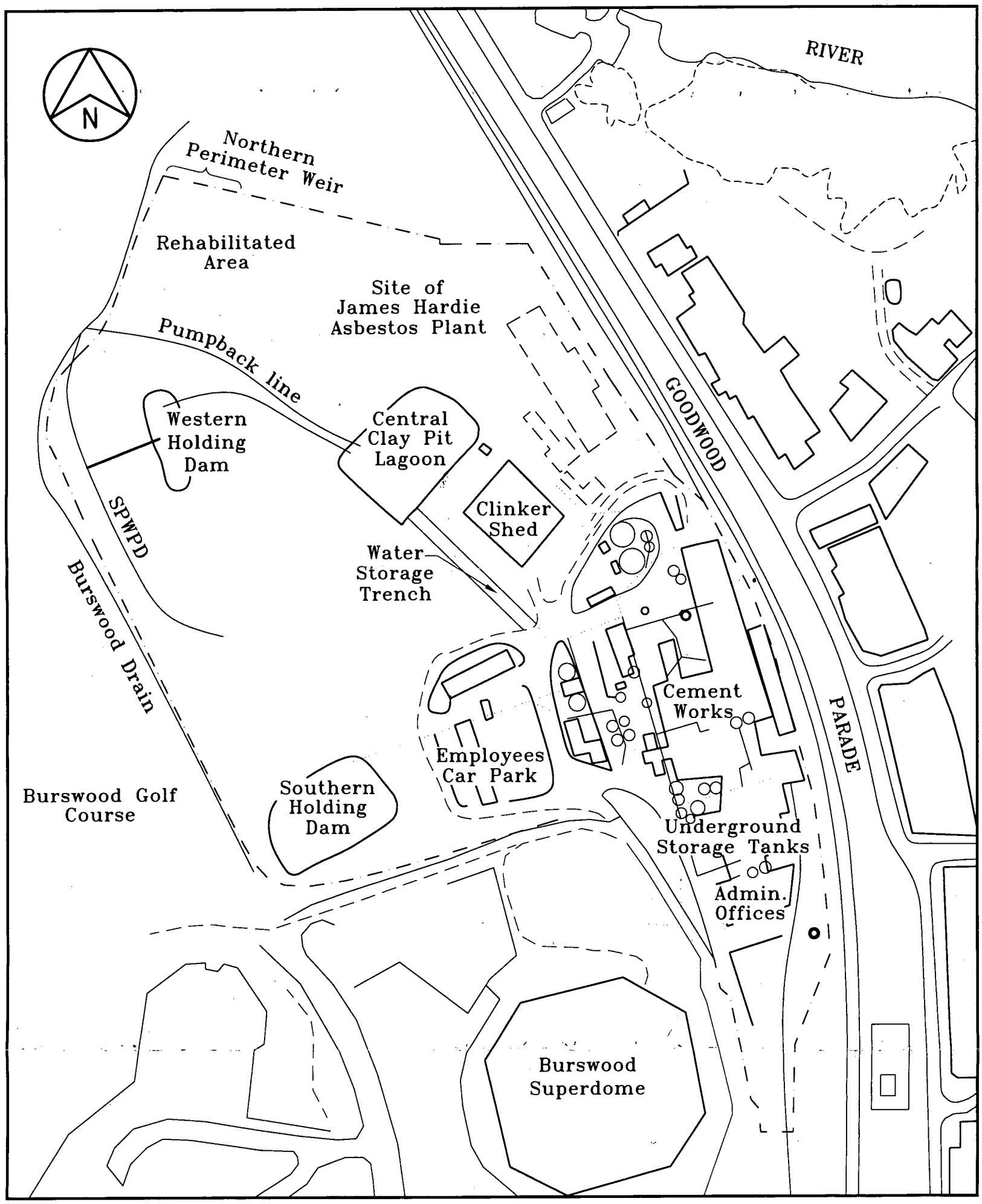
SWAN PORTLAND
SITE LAYOUT

FIGURE 9



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2.2.3 Surface Hydrology

Surface water is collected by a network of constructed drains that channel stormwater off-site. These drains have also collected process waters from the plant in the past. Figure 11 shows the major drains within Swan Portland's site.

The Burswood Drain and the Swan Portland Western Perimeter Drain (SPWPD) run in parallel along the western perimeter of the site. The drains connect about 140 m from the northern boundary of Swan Portland's site. This single drain then flows east and discharges into the Swan River.

A collection sump has been constructed directly downstream of the confluence of the two drains to assist with sedimentation control. Collected alkaline water discharged through the SPWPD is diluted with runoff from the Burswood Drain upon their joining and collects in the constructed sump. Water and entrapped sediment is then pumped back to the water storage trench.

In the past government authorities have examined discharges from the Burswood Drain particularly in relation to the accumulation of a limestone-like, calcareous sludge within the drain and the general alkalinity of the drain water. The Swan River Trust have specified discharge license conditions for the drain which include an acceptable pH range of 5 to 9. Monitoring of drain water quality over several years has shown that the pH limit of 9 has not been exceeded in the final discharge to the Swan River. A detailed description of the nature of the drain waters is provided in Appendix B.

The extent of the floodway from a one in a hundred year flood event for the Peninsula is restricted to a fringe of land immediately adjacent to the Swan River. The 100 year flood fringe is located to the immediate north and outside the boundary of Swan Portland's site. Any proposed building development within Swan Portland's site will not be restricted by the requirement to import fill as existing land surfaces are above the flood fringe level (Ove Arup and Partners, 1993).

2.2.4 Hydrogeology

Studies of groundwater within the site indicate that groundwater movement flows north-westerly and out through the Peninsula to the Swan River (Ove Arup and Partners, 1993). Groundwater also enters the Swan Portland and Burswood drains as it leaves the western perimeter of the site.

Groundwater flow across the site was historically affected by the clay pit lagoon which received both surface water from drains and discharges from the plant. The lagoon created an artificial positive head of water that resulted in the formation of a groundwater mound from which water dispersed rapidly across the site.

Use of the clay pit lagoon was discontinued in early 1995. This has resulted in a reduction in the mound under the lagoon and a decrease in the rate of groundwater flow from the site.

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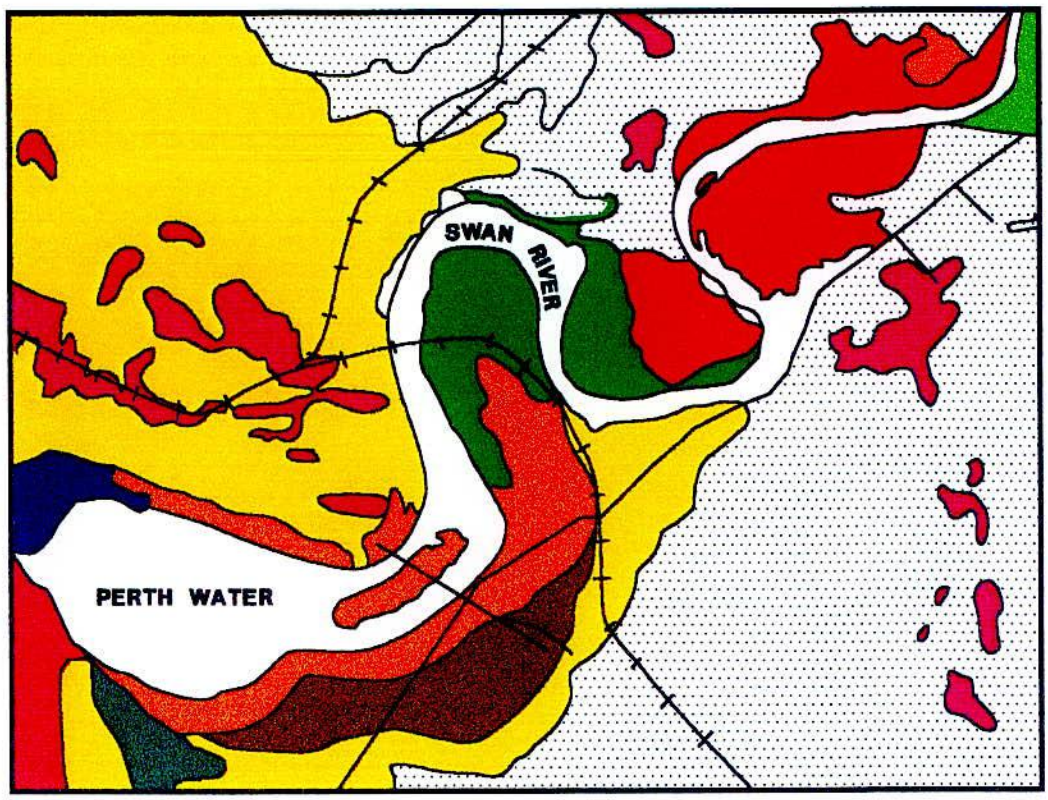
GEOLOGY & SOILS OF BURSWOOD PENINSULA AND SURROUNDS

FIGURE 10



LEGEND

Map Unit	Description	Equivalent Geological Unit
	PEATY CLAY	Swamp deposits
	PEATY SAND	
	SAND	Alluvium
	CLAY	
	CLAYEY SILT	
	SANDY SILT	
	SILTY SAND	
	SAND	Sand derived from Tamala Limestone
	LIMESTONE	Tamala Limestone
	SAND	Thin Bassandean sand over Guildford formation
	SAND	Bassandean sand
	FILL	

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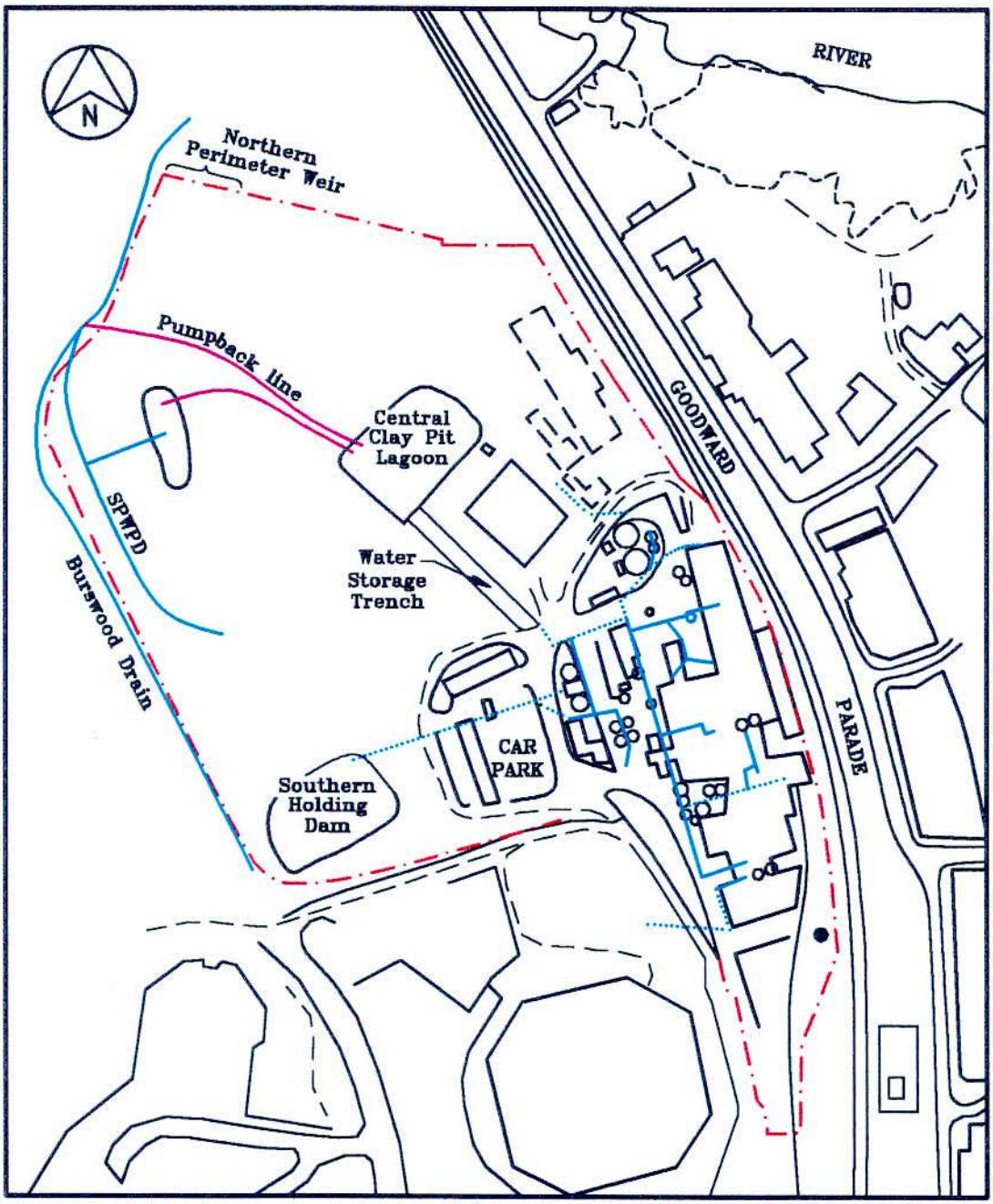
ENVIRONMENTAL

SWAN PORTLAND DRAIN NETWORK

FIGURE 11



LEGEND

- ABOVE GROUND PIPE
- OPEN DRAIN
- UNDERGROUND PIPE
- FENCE

SPWPD–Swan Portland's Western Perimeter Drain

0 100m
SCALE

RDS No: N/A DATE OF LAST EDIT= 16/07/1996-16.07 CAD FILE: J:\PROJECTS\WE0767\FIG5

Water table level fluctuations recorded at the Burswood Island Resort suggest that an annual range of less than one metre occurs. Maximum groundwater levels within Swan Portland's site are limited by the existing drains that traverse the site. The depth of the drains and the northern perimeter weir control the groundwater height by collecting and discharging groundwater and surface drainage to the Swan River (Golder Associates, 1996b).

A detailed description of the chemical characteristics of the groundwater beneath the site is provided in Appendix B.

2.3 BIOLOGICAL ENVIRONMENT

2.3.1 Flora and Fauna

At the time of European settlement in 1829, Burswood Peninsula was part of extensive mud flats which stretched from the western edge of the Peninsula to the lowest of the Heirisson Islands (Wishart, 1994). The mudflats were regarded as unattractive and no effort was made to preserve this habitat.

By the 1960's the mud flats and its associated flora had completely disappeared and the Burswood area had been completely degraded. In 1984, the Burswood site was reportedly "a scruffy, unkempt foreshore reserve and blight on the city landscape" (Burswood Park Board, 1996).

The lack of native vegetation and the filling of the site has resulted in very little habitat for fauna on the Swan Portland site. There are no records of any rare or endangered species occurring on the Burswood peninsula.

2.4 HUMAN ENVIRONMENT

2.4.1 Community Consultation

Swan Portland has a strict policy of consulting with any authorities, groups or individuals that are affected by its projects or developments. In the past 12 months the company has demonstrated its commitment to this policy in connection with developments at Kwinana and Exmouth.

Prior to the public release of this document, and during a range of earlier studies of the property associated with this project and the rezoning of the site, the following groups and agencies were contacted:

- Burswood Park Board
- Burswood Resort Casino
- Department of Environmental Protection
- Department of Land Administration
- Department of Planning

- Department of Main Roads
- Environmental Protection Authority
- Swan River Trust
- Tennis West
- Town of Victoria Park
- Union representatives
- Water Corporation of Western Australia
- Waters and Rivers Commission
- Westrail
- WorkSafe

In addition to these groups, Swan Portland has informed the occupants of properties along Goodward Parade about the PER and the dates of the period for public environmental submissions on its plans.

The site has received significant media coverage. A media release announcing the proposed sale and redevelopment of the Swan Portland site was issued on 28 February 1996 and articles based on this information were published in the local paper, The Southern Gazette, The West Australian and Business News. An update on the future of the site was published in The West Australian on 31 July 1996 and an article on the environmental work to be carried out at the site was printed by The Sunday Times on 4 August 1996.

During the PER period, the company will continue to consult with its neighbours and relevant local authorities on any issues that may be relevant to them.

Once the remediation work commences, Swan Portland will maintain close contact with its neighbours and will inform them of any activities on the site that may impact on them.

2.4.2 European Heritage

The majority of buildings at the plant are corrugated iron sheeting over steel frames which replaced timber frameworks and asbestos sheeting in some places. The recent buildings have little or no significance and only the main office which is located near the entrance of Great Eastern Highway conforms to the accepted definition of architecture. This 1927 building has been altered, but remains indicative of architecture of its period.

The site has little social significance for local residents or the general public, thus closure of the plant will not cause any significant social or economic impact. The processes undertaken at the site may provide some scientific interest, however the techniques used are common throughout Australia (Bell *et al.*, 1996).

2.4.3 Aboriginal Heritage

Two significant aboriginal sites located near the Swan Portland site are registered at the Aboriginal Affairs Department. One of these is Heirisson Island, the other is an old aboriginal campsite near the Belmont Racetrack. Neither of these sites are affected by this proposal.

SECTION 3
ENVIRONMENTAL ISSUES

3.1 INTRODUCTION

The most significant environmental issue associated with development of the site is the presence of materials that may compromise its future use. An extensive investigation programme has been performed by the proponent to identify these materials.

Investigation has been performed over a six year period and has involved over ten individual studies. This programme is based on historical knowledge collected on the site (see Section 2.1). Groundwater monitoring bores, and pits have been excavated with the object of defining the extent of materials. Samples of groundwater and soil were collected and analysed to characterise these materials.

The proponent is confident that there is sufficient knowledge of the site to plan a suitable remediation strategy. Further investigations are ongoing to fine tune the proposed remediation.

The following sections in the document provide information on the different materials on-site. Full descriptions of the investigations performed are provided in the site investigation reports referenced in these sections.

3.2 ASBESTOS

Asbestos was originally known to occur on the Swan Portland site in two main forms:

1) above the ground in the form of asbestos-cement sheeting which had been used in the construction of the large factory building and other buildings; and
2) below the ground where asbestos remnants, off-cuts and other wastes have been buried on-site (Amdel, 1988).

To date three rounds of site investigation have been undertaken to assess the extent of asbestos on the site. These are as follows:

- Preliminary studies were undertaken on areas known to be contaminated with asbestos in 1983-84. Investigations were limited to the Hardie's property only.
- Two studies were undertaken in 1988, the first on the James Hardie site, and the second on areas surrounding the James Hardie site (Amdel, 1988). The study allowed characterisation of the asbestos waste both in soil and the James Hardie factory building.
- The most recent study in January 1996 used the Victorian EPA's guidelines issued for transport and disposal of asbestos to distinguish the extent of contaminated soil (Golder Associates, 1996b).

The maximum volume still present is about 65,000 m^3. This material occurs as a continuous body which has a depth of up to 4.5 m below ground level. Asbestos fragments and fibres are known to occur at several locations, including the former mixing area for cement and raw asbestos, and beneath concrete foundations. Crushed asbestos cement sheeting occurs on the eastern boundary of the site. The extent of asbestos containing material (ACM) is shown in Figure 12.

Three types of asbestos are found on the site, white (chrysotile), blue (crocidolite) and brown (amosite). Two types of asbestos cement sheeting have been identified, one with 7 to 10% blue asbestos and 3 to 5% white asbestos, and the other with 10 to 15% white asbestos and 0.3 to 0.5% brown asbestos.

Blue and brown asbestos are known to be more dangerous than white asbestos because of the physical characteristics of their fibres which make them more likely to penetrate and lodge within the respiratory system.

Air monitoring before, during and after recent site investigation work has confirmed that NOHSC occupational exposure standards have been met with regard to airborne dust.

3.3 CEMENT KILN DUST

Cement kiln dust (CKD) is a large volume by-product of the cement production process. When the raw materials are fired within the rotary kiln, an extremely fine dust is formed which is purged in the exhaust gases from the kiln. The gases containing the particulates are passed through an electrostatic precipitator which collects the dust prior to direct venting of the exhaust to the atmosphere.

The collected CKD has in the past been deposited over the site as fill. Interpretation of aerial photographs indicates that the employees carpark has been progressively filled with CKD. CKD has also been extensively deposited in the central, northern and now partly grassed north-western section of the site (Figure 13).

Ground surface contours mapped in August 1989, indicated that up to 10 m of fill has been placed in the north and west sectors of the site. It is understood that the precipitator material was allowed to run off along the surface, to be retained by small dykes which were progressively positioned around the site as the elevation of the fill increased.

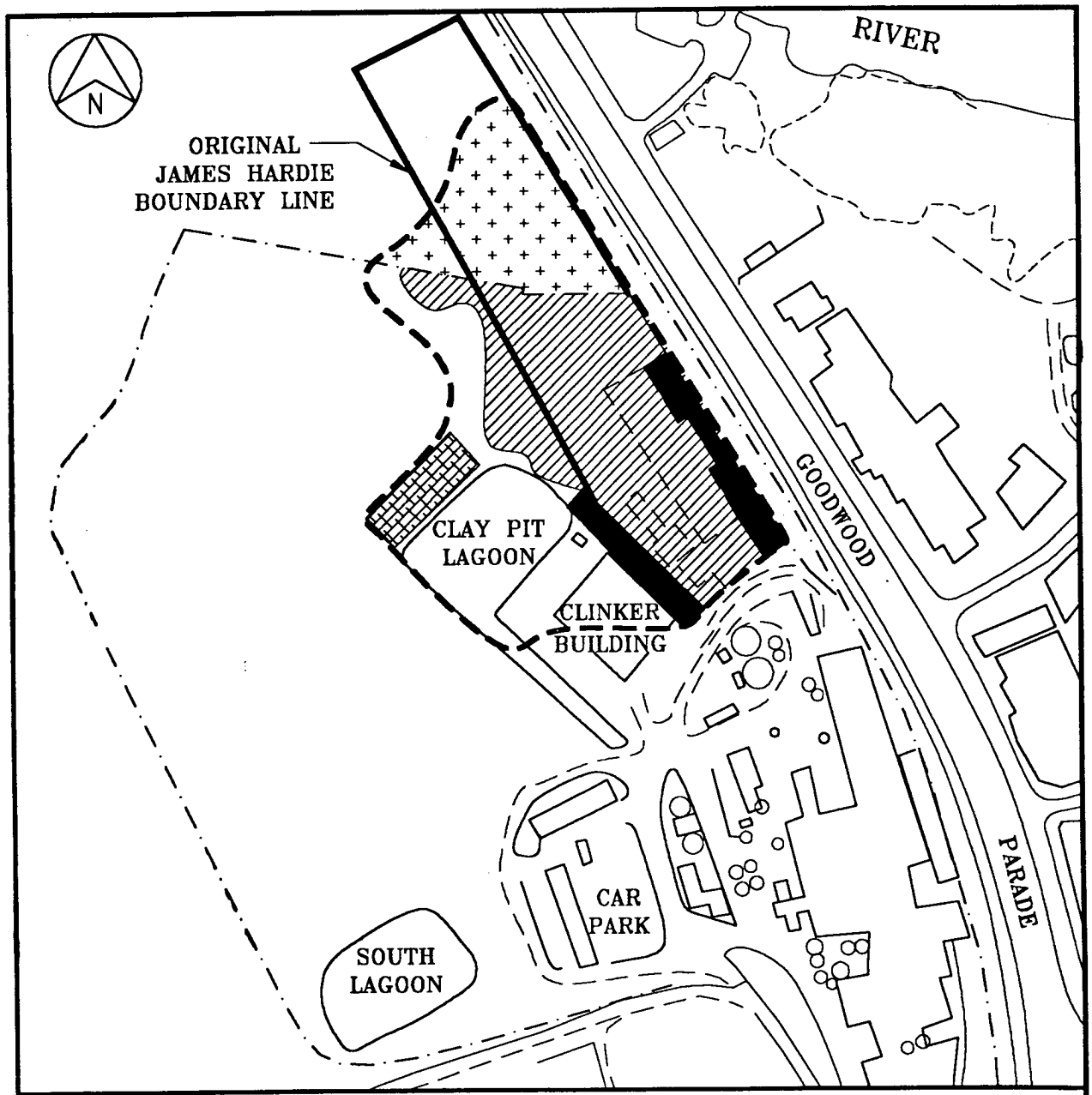
No historical records are available on the depth of the excavation of the former clay pit, however, it has been estimated that CKD occurs to about 10 m below the mounded watertable. The clay pit was progressively filled over the past few decades with precipitator material that was disposed underwater.

The CKD is made up of material derived from natural raw materials used in the manufacturing process. Specifically the dust includes fine particles of calcium carbonate, silicon dioxide, iron and aluminium oxides, sodium and potassium chlorides

CMPS&F ENVIRONMENTAL

FIGURE 12

SWAN PORTLAND
EXTENT OF ASBESTOS WASTE



LEGEND

- Possible extent of asbestos contamination
- Site boundary
- Known asbestos buried on-site
- James Hardie boundary line
- Asbestos fill removed and replaced by limestone
- Relocated asbestos material removed by Gardener Perrott in 1989
- ACM removed by the Main roads department in 1984 & 1986

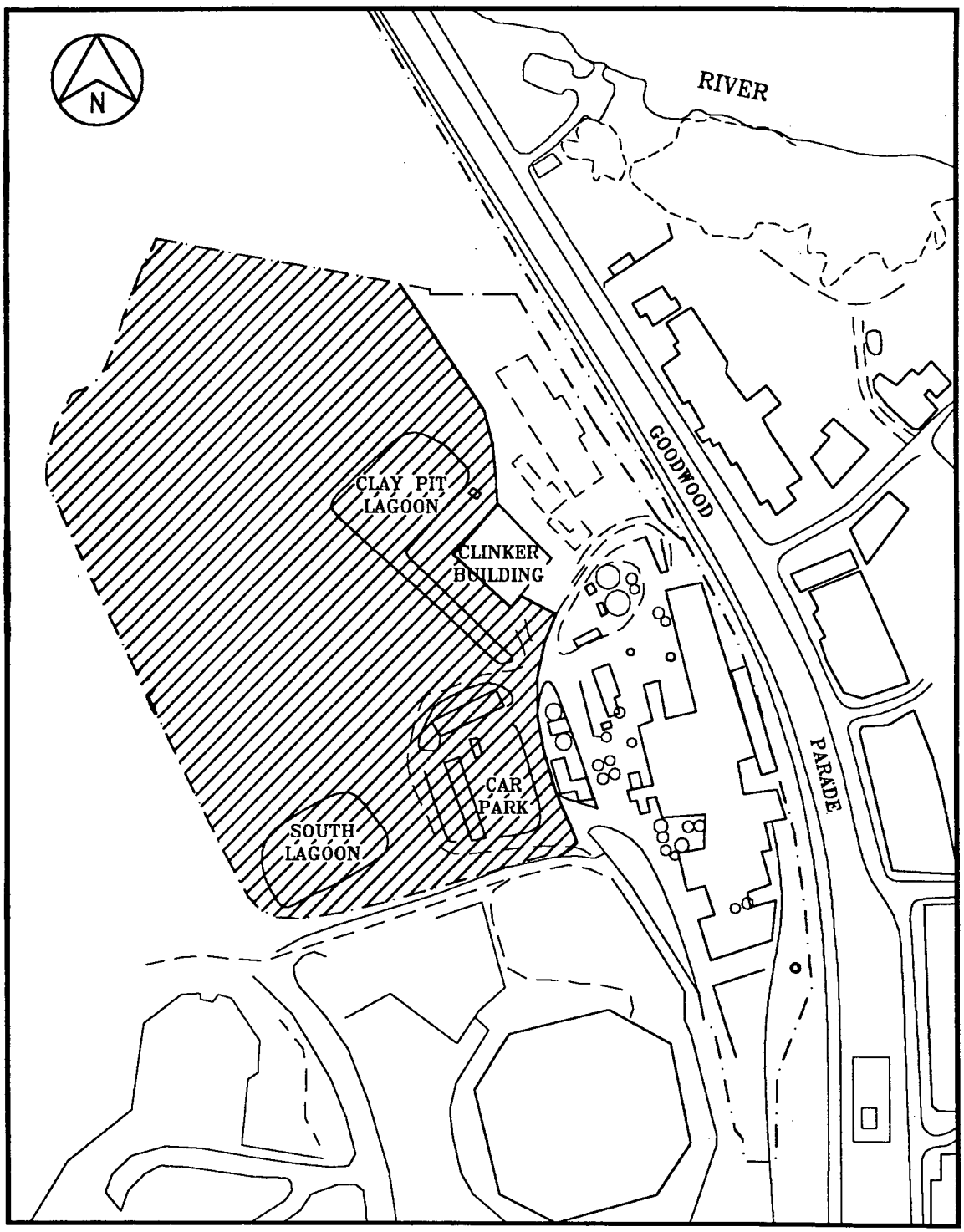
0 100m

SCALE

RDS No: N/A DATE OF LAST EDIT: 03/07/1996-10.29 CAD FILE: J:\PROJECTS\WE0767\FIG11

CMPS&F
ENVIRONMENTAL

FIGURE 13
SWAN PORTLAND
LOCATION OF CEMENT KILN DUST



LEGEND

Site Boundary

Cement kiln dust

0 100m

SCALE

RDS No: N/A DATE OF LAST EDIT= 03/07/1996-08.49 CAD FILE: J:\PROJECTS\WE0767\FIG12

and sulfates and various salts. Monitoring of the composition of CKD has been routinely undertaken by Swan Portland over the last decade. The composition of CKD has varied little over the years of cement production and its composition is uniform and inert (Ove Arup and Partners, 1993). A detailed description of the characteristics of the cement kiln dust is provided in Appendix B.

Metal concentrations in kiln dust are dependant upon levels in the raw materials and fuels used in the plant. The overall composition is determined by design and operational practices of the kiln. Analysis of heavy metals within CKD has determined concentrations are within the same range found in normal soils.

Although CKD is inert the dust is alkaline due to its lime content. As a consequence, water that permeates through CKD filled areas also becomes alkaline. However the CKD has a low permeability due to its fine grained nature. Lime is highly soluble and when it dissolves it raises the pH of the water.

The implications of the alkaline groundwaters are addressed in Sections 3.6 and 4.4.

3.4 KILN BRICKS

Alumina and chromate bricks were used to line the rotary kilns in Swan Portland's plant. The bricks have heat retarding properties and reduce thermal fatigue of the outer metallic casing of the kilns. The bricks have a limited life and are periodically removed from the kiln when their thickness has been substantially reduced (Ove Arup and Partners, 1993).

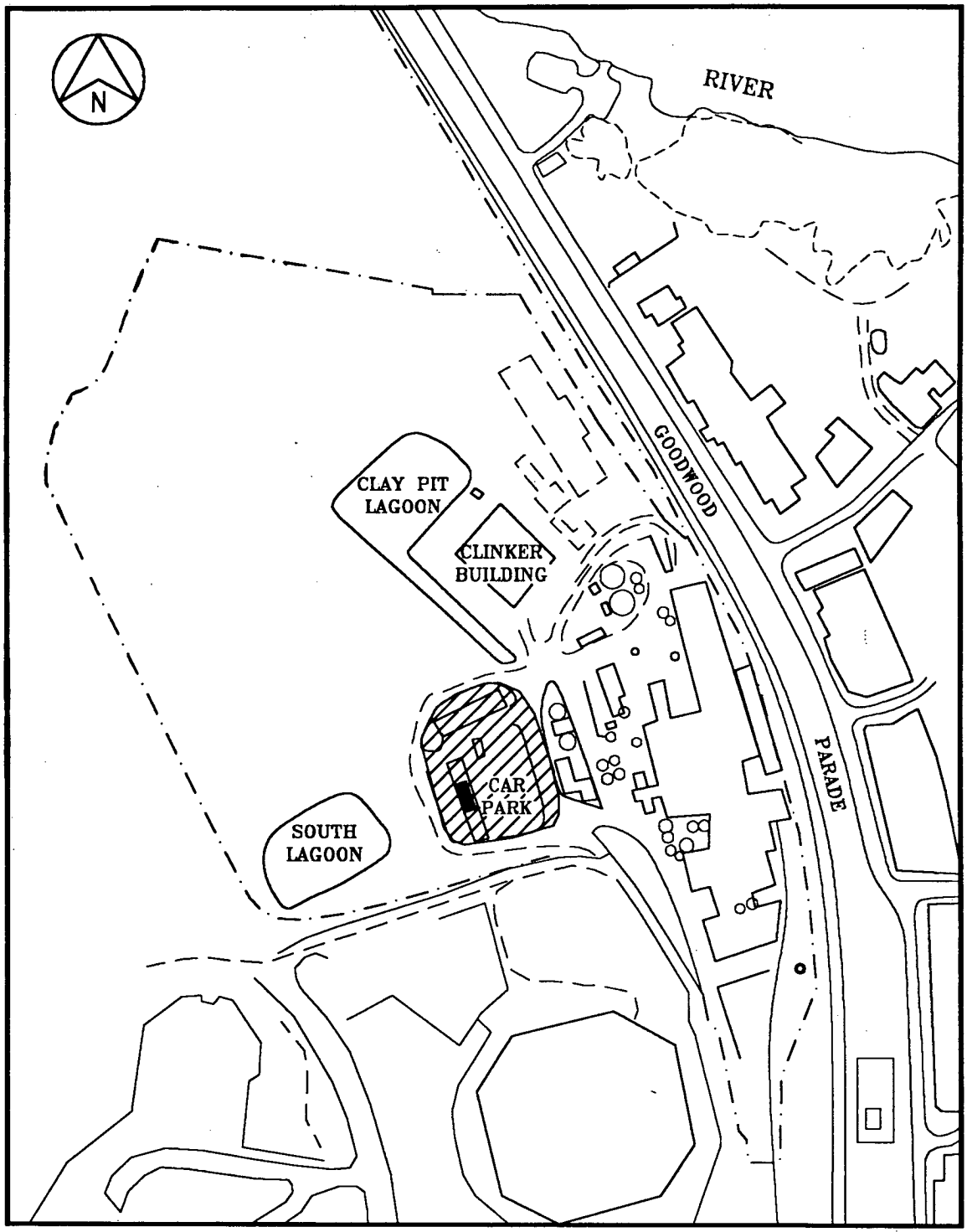
Although kiln bricks are currently disposed of off-site, they were historically disposed of on-site, contributing to fill material. The majority of bricks are thought to be sealed in CKD under the present car park (Figure 14). Anecdotal evidence suggests that disposal practices were relatively haphazard and disposal locations varied over time.

Historical evidence indicates that kiln bricks can produce chromate bearing leachate in the presence of acidic water. However, groundwater studies undertaken at this site have identified concentrations of chromium, chromate and their derivatives to be at levels well below Department of Environmental Protection (DEP) guidelines for the protection of health and the environment.

Total heavy metal composition and leachate tests were conducted on an alumina brick, two chromate bricks, kiln coating material and soil from beneath the bricks. Results indicate that the material is acceptable for disposal at a suburban landfill that accepts low hazard solid waste (Class IV). A detailed description of the characteristics of the kiln bricks is provided in Appendix C.

CMPS&F ENVIRONMENTAL

FIGURE 14
SWAN PORTLAND
LOCATION OF BURIED KILN BRICKS



LEGEND

- Kiln brick waste test trench
- Site Boundary
- Known extent of buried kiln bricks

0 100m

SCALE

RDS No: N/A DATE OF LAST EDIT= 16/07/1996-11.46 CAD FILE: J:\PROJECTS\WE0767\FIG13

3.5 BURIED OIL DRUMS

Historical aerial photography from 1973 has shown that green 'BP drums', likely to contain lubricating oil were stored in the vicinity of the clinker shed in a number of locations. Evidence from staff interviews suggests that between 400 and 500 200 litre drums of oil were buried at the site. These disposal areas diminished in size from 1973 through to 1979. It is not clear from the aerial photographs whether the drums remained in-situ, were removed altogether or relocated. In 1981 no remnant of the disposal areas were visible. Recent geophysical investigation has, however, located buried oil drums to the west of the clay pit lagoon.

Historical evidence indicates that during covering operations, many of these drums were ruptured, and some of the contents released. Recent drilling in the vicinity of the buried drums has identified a layer, between 1.8 and 4.0 m thick, of heavy oil saturated sand beneath 2 m of CKD. The extent of this area is shown in Figure 15.

3.6 FUEL STORAGE TANKS

Two areas on the Swan Portland site are known to contain underground storage tanks (UST). One abandoned UST is present near the southern end of the Hardie asbestos plant. The other area, located near the Swan Portland office complex, has one UST which is currently in use. It contains diesel which supplies fuel for the company's trucking fleet. Another UST is present here, however, this was decommissioned and filled with water and an anti-rust agent (Kinhill, 1990).

Two large aboveground fuel oil storage tanks are still on the Swan Portland site. The tanks originally contained diesel fuel oil that was a back up emergency supply for the kilns. No back up fuel is presently stored on site and the two tanks have been decommissioned and vented (Ove Arup and Partners, 1993).

Drilling in the vicinity of the tanks has failed to identify any fuel in the ground.

3.7 GROUNDWATER

The groundwater gradient across the Burswood Peninsula is minor, and flows are locally influenced by on-site activities. Historically, the clay pit lagoon has received process waters from the plant which created a groundwater mound. A reduction in groundwater levels of approximately 1m has coincided with the discontinued use of this lagoon. The groundwater is presently mounded beneath the water storage trench at a height of approximately 4m AHD elevation as shown in Figure 16.

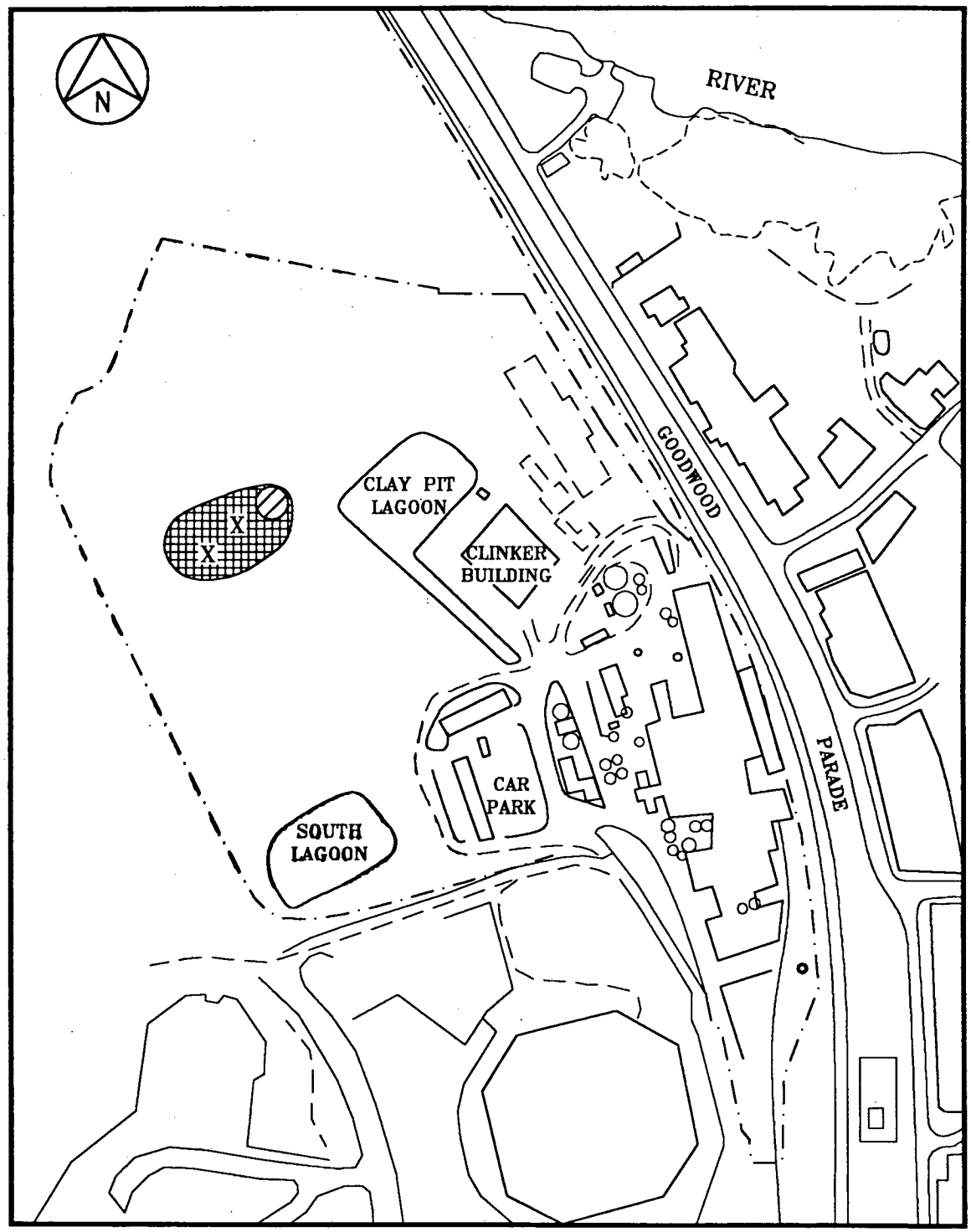
Water quality investigations indicated that the groundwater under the Swan Portland site has elevated pH levels. As water passes through the buried CKD, which consists predominantly of lime, the lime dissolves and the pH of the water becomes alkaline (Ove Arup and Partners, 1993). A detailed description of groundwater quality is given in Appendix D.

CMPS&F
ENVIRONMENTAL

FIGURE 15

SWAN PORTLAND

LOCATION OF BURIED OIL DRUMS AND EXTENT OF CONTAMINATION



LEGEND

- Oil drums location
- Site Boundary
- Estimated location of oil Contaminated soil
- X Sample locations

0 100m
SCALE

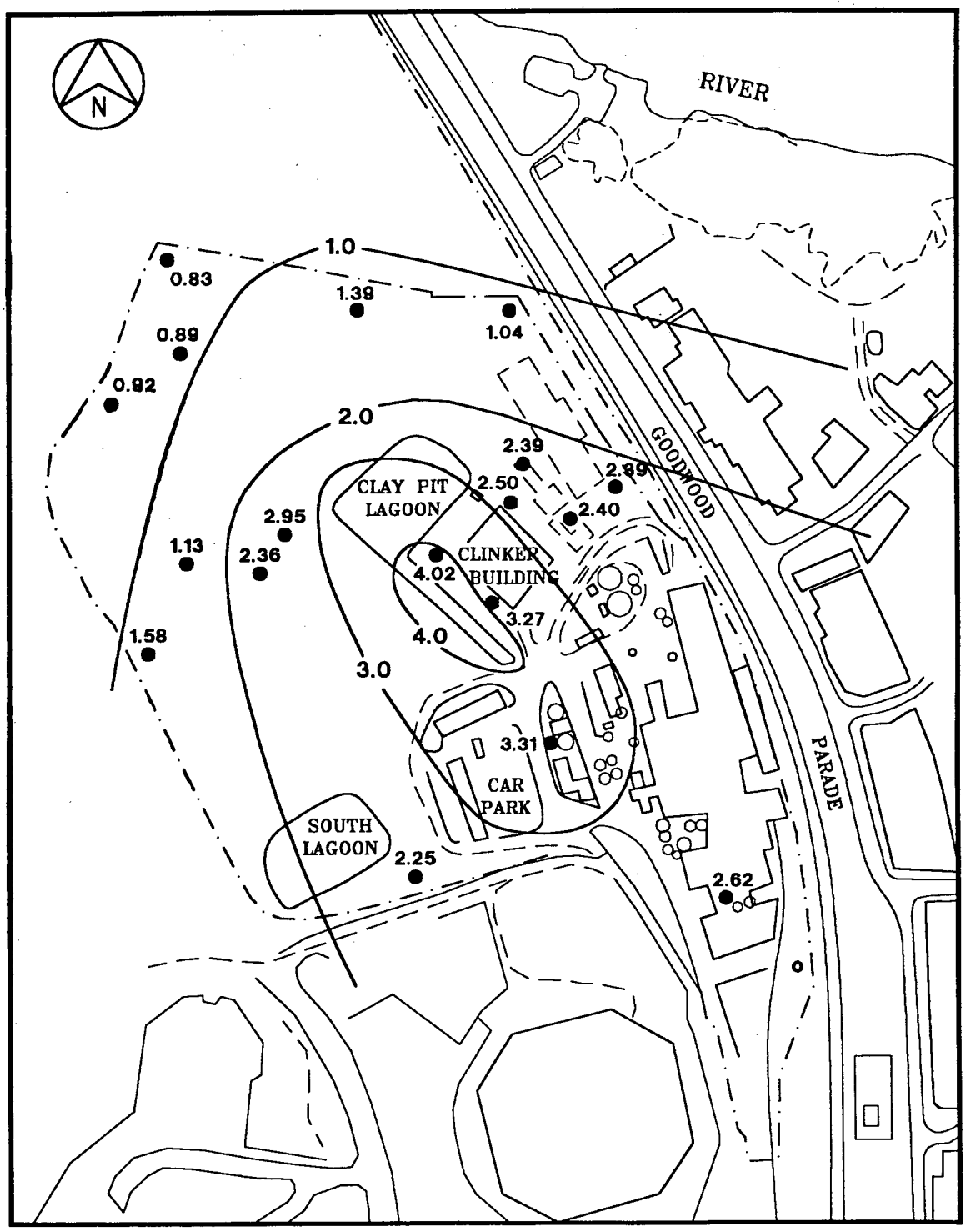
RDS No: N/A DATE OF LAST EDIT= 03/07/1996-09.41 CAD FILE: J:\PROJECTS\WE0767\FIG14

CAMPBELL & F
ENVIRONMENTAL

FIGURE 16

SWAN PORTLAND

ESTIMATED GROUNDWATER LEVEL CONTOURS



LEGEND

- ● Bore, Groundwater level (m AHD) 16.5.96
- — · — Site Boundary
- —ac— Groundwater level contour (m AHD) 16.5.96, Estimated

0 100m
SCALE

RDS No: N/A DATE OF LAST EDIT= 16/07/1996-11.55 CAD FILE: J:\PROJECTS\WE0767\FIG15

Other than elevated alkalinity and the minor impact of the lubricating oils described in Section 3.4, the groundwater is considered to be uncontaminated.

SECTION 4
ENVIRONMENTAL MANAGEMENT

4.1 INTRODUCTION

The following section describes how the proponent proposes to manage the environmental issues previously identified in Section 3. These issues are predominantly related to the removal, treatment and disposal of waste material that have the potential to compromise the future development of the site. Upon completion of the implementation phase the proponent will report to the DEP on success in meet the management commitments and ministerial conditions for the project.

The initial sub-sections deal with the demolition of the plant and the removal of each type of material found on the site. Latter sub-sections describe the management of issues such as noise and dust that are common to all construction activities. The primary objective of the work is to render the site suitable for residential development by meeting the relevant environmental criteria.

4.2 DEMOLITION OF PLANT

All structures and equipment on the site are to be demolished and removed. Some of the cement and lime manufacturing equipment will be moved to Swan Portland's new facility in Kwinana. The remainder will be sold for scrap or disposed to landfill. All footings for buildings are to be totally removed.

Prior to demolition a hazardous waste survey will be performed over the entire building complex. Building materials unsuitable for disposal to an inert landfill will be documented. Appropriate methods for separation of these materials from inert materials will be prepared. Hazardous materials including asbestos contaminated material will be disposed as recommended by the Waste Management Division of the Department of Environmental Protection.

Services such as gas, water and electricity will be disconnected prior to the commencement of demolition. These services will be removed from the ground as a first stage in the demolition.

A significant amount of dust could potentially be generated during demolition. This will be managed by methods described in Sections 4.3.2 and 4.10.3.

4.3 ASBESTOS

4.3.1 Clean-Up Criteria

It is proposed that all asbestos containing material will be excavated from the site and disposed of to landfill. Material containing asbestos is classified as Asbestos

Containing Material (ACM) if it is in a friable, finely divided or powdered state and contains more than 1% asbestos by weight. Use of the 1% criteria is consistent with Victorian EPA guidelines (Vic EPA, 1995) and Californian treatment standards (Nieto, 1990) for asbestos containing waste. The proponent will liaise with the Department of Health with regard to the criteria to ensure they are appropriate for the final end use of the site.

Using this criteria it is estimated that a maximum of 65,000 m^3 of material will need to be removed or processed. The resulting excavations will be backfilled with material imported from off-site.

4.3.2 Excavation and Transport

Special handling procedures are required for the handling of materials containing asbestos. These requirements are detailed in the Code of Practice for the Safe Removal of Asbestos (NOSHC, 1988). The proponent is committed to performing all asbestos removal works in accordance with this code. In summary, the following procedure will apply.

- The suspected asbestos containing material (ACM) will be excavated, under strictly controlled wet conditions and validated.
- The verified ACM will then be transferred as soon as is practicable to lined, covered and appropriately labelled trucks.
- These trucks will be washed thoroughly before leaving the site.

Trucks will then proceed off-site to the chosen landfill for disposal in a safe manner. The exact location of possible landfill sites will be provided once the results of tenders for the various site operators are known. However, it is likely that an appropriately licensed inert landfill or landfills on the Swan Coastal Plain will be used.

As the destination of the material is not known the route to be taken by trucks has not been finalised. Trucks will however keep to major highways and properly made roads during the entire transport operation.

Some form of wet screening to allow the separation of the ACM and general rubbish could be employed to reduce the volume of ACM requiring disposal to landfill. If adopted, this would be carried out in a contained, or semi-contained space to prevent the off-site migration of ACM dust and to minimise the generation of excess noise. Dust levels would be kept within those levels specified in Section 4.3.3.

4.3.3 Dust

Fine water sprays will be used to control dust and these at all times will conform to the Code of Practice for the Safe Removal of Asbestos. The use of fine water sprays will serve to limit ACM dust generation and minimise water runoff from this area. If excavation proceeds below the water table then the use of fine sprays will be

maintained only on soils above the groundwater table, including areas of truck movement and stockpiling.

Daily cover, most likely in the form of plastic sheeting, will be applied to any stockpiles and current excavation sites to prevent the overnight dispersal of dust off-site.

An air monitoring programme for asbestos will be put into place before, during and after excavation work. It will include daily testing of air on the site boundaries and the use of personal monitors on all staff involved. Sampling and testing protocols will be set in consultation with Worksafe WA and the Department of Health. It is envisaged that a membrane filter sampling method will be employed with dust samples being assessed by a NATA registered laboratory.

Acceptable exposure limits will be set at 1 fibre/ml for white asbestos and 0.1 fibre/ml of other types of asbestos in line with NOHSC occupational exposure standards for workers on-site. More stringent standards will be employed for dust emissions from the site. These will be set after consultation with the Department of Health and the DEP.

Work practices will be changed if the results show that a potential hazard is developing. The results of the air monitoring programme will be documented and summarised in reports for the DEP upon completion of the implementation phase and during the post-excavation phase.

4.3.4 Disposal Operations

At the disposal site a similar level of air monitoring and dust suppression will be put in place. The asbestos waste will be covered with a layer of soil or other material 300 mm thick prior to compaction. No ACM will be placed within 2.0 m of the final landfill surface. Trailers will be emptied only at the base of slopes at the disposal site and will be water washed at the disposal site prior to leaving the disposal site. The operator of the landfill will record the location and depth levels of the ACM within the landfill site and plans produced will be lodged with the local council and the DEP.

4.3.5 Other Options Considered

At an early stage in the planning of the decommissioning it was decided that the ACM would not be left on the site. This practice has been performed elsewhere including on adjacent parts of the Burswood Peninsula. However it was decided that the material would compromise the future development of the site and thus it needed to be removed.

There are a number of possible alternative methods to landfilling that could be employed to deal with ACM. However at this stage simple disposal to landfill is most likely.

Sorting based on particle size could be performed to concentrate the ACM. This process could be carried out in either the wet or dry state, and would be managed so as

to not release asbestos dust to the surrounding environment. This process would separate the ACM from soil by passing the mixture through an upward current classifier. On separation, the ACM would be transferred to trucks and transported to landfill. The remaining fill material would then be verified as clean fill by testing and returned to site.

The use of SMITE (Synthetic Mineral Immobilisation Technology) was considered as a chemical method for treating the ACM encountered on-site. This process relies on the use of a proprietary chemical to lower the melting point of asbestos. On firing, the chemical mixture of additives and ACM a fibre-free glassy slag suitable for use as a roadbase or other construction material is formed. Whilst such a technology avoids landfilling of the ACM, it is not commercially suitable for the work at hand.

4.4 CEMENT KILN DUST

The cement kiln dust is an inappropriate material on which to found buildings as it has a weak structure with low load bearing capacity. Ordinarily such material would have to be removed to allow the safe construction of buildings. However as the dust lies on soft river muds which have this same characteristic there would be no gain in removing it. Thus piles will need to be driven into the ground to provide foundations for buildings regardless of the presence of CKD and there is no need to remove the dust from site.

As the dust contains background levels of contaminants there is no need, from an environmental perspective, to remove it from site. The material does have a high alkalinity and thus will be covered with at least 0.5 m of topsoil. This will allow parkland vegetation to be established and will prevent people from coming into contact with it as the lime can be irritating to the skin.

It is expected that where excavations need to be made, say for services or construction purposes, the dust will be excavated and disposed of appropriately. This material will then be replaced with sand fill.

The proponent has considered the potential to use the dust as a soil enhancer for acidic agricultural soils. Market research has found that there is not a ready market for the material. Farmers are unlikely to be prepared to pay the cost of excavating and trucking the material to the wheatbelt. The proponent will continue to investigate this use for the material however it seems unlikely that significant volumes will be used.

4.5 KILN BRICKS

Kiln bricks are known to occur within an area beneath the store yard and car park (Figure 14). Testing has found that there is no need to remove the bricks from an environmental perspective (Section 3.3). However, because volumes are relatively small and these bricks are most often associated with general rubbish, the proponent proposes to remove them from site and dispose of them to landfill.

All kiln bricks and general rubbish encountered will be removed. The kiln bricks and other rubbish will be transported to landfill in trucks with tarpaulin covers to minimise dust generation.

4.6 BURIED OIL DRUMS

It is proposed that the drums containing lubricating oils and any soil contaminated with these oils will be excavated and treated by bioremediation. Bioremediation involves the cultivation of bacteria that consume the oils and convert them to simple chemical compounds such as water and carbon dioxide. Typically the soil will be turned regularly to aid this process. Destruction of the oils will be monitored and when levels are sufficiently low, the material will then be either used as fill on-site or disposed of to landfill.

Treatment will be performed on a lined area from which stormwater will be collected in a pond. This will avoid contaminating any further soil. Collected water will be recycled to maintain the necessary moisture content in the treatment beds.

4.7 FUEL STORAGE TANKS

The underground storage tanks on-site will be removed using standard procedures, soon after decommissioning of the site. Should fuel from the tanks be detected in any soils, their disposal or treatment will be co-ordinated with that for the soils containing lubricating oils (Section 4.6).

A drilling and sampling programme will be part of the removal process of storage tanks. Hand auger borings will be conducted to collect soil samples from the area surrounding the oil storage tanks. Any spills or leaks which may have occurred during the operation or filling of the tanks will be assessed during demolition.

4.8 GROUNDWATERS

Groundwaters beneath the site are known to be alkaline as a consequence of contact with lime in the buried cement kiln dust (see Appendix D). However the groundwater table is elevated above its natural level because of water discharges via water disposal to the ponds and open drains (Section 2.2.4).

Groundwater studies indicate that once stormwaters and process waters are no longer discharged to the ponds and drains the watertable will drop. Over most of the area of the site this will be at the natural groundwater table. As a consequence the leaching of the cement kiln dust will be reduced and thus through time the alkalinity in the groundwater will decrease.

The proponent will monitor groundwaters on an ongoing basis to confirm the abovementioned process occurs. This information will be documented and reported to conform with management commitments.

4.9 LONG TERM SURFACE WATER MANAGEMENT

The proponent is mindful of the need to minimise the infiltration of water through the cement kiln dust that remains on-site and as such proposes the following management techniques.

It is proposed that all stormwater collected from buildings and hardstand areas will be piped in a sealed stormwater system to the Swan River. This system will replace the existing system of open drains (Section 2.2.3). It is envisaged that this system could also collect stormwater which originates from the adjacent Burswood carpark and Golf Course. However no formal discussions have been held with neighbours on this matter.

The advantage of a piped system is that it limits recharge to the groundwater minimising the generation of alkaline groundwaters. It also removes the need to manage the existing drain in the long term as has been required in the past (Section 2.2.3).

At this stage it is expected that a large diameter drain, which will collect all stormwater, will be laid along the current alignment of the Burswood Drain (Figure 11).

During works it is proposed that the surface of the cement kiln dust will be contoured to promote the draining of waters over its surface. Areas where water from the surface may pond will be leveled. Consideration will be given to promoting the flow of water away from this area by installing agricultural drains to collect shallow subsurface water. This would discharge to the piped stormwater system.

4.10 GENERAL SITE MANAGEMENT

A range of sound working practices will be implemented to minimise the potential spread of excavated materials during excavation and handling activities. The work practices discussed here will apply to all areas of work as appropriate.

4.10.1 Materials

- All excavated soils containing ACM, oils or chromate bricks will be subjected to a consignment system if they are to be taken off-site. This allows for a complete record of the destination of excavated materials. A record of quantity will be kept for materials transported from any excavation.

- Any contaminated soils to be transported will be taken in covered and sealed trucks. Trucks transporting ACM will have special containment measures (Section 4.3.1). Each truck will have a power locking tail gate which can only be released from inside the truck cab.

- Samples from soils off-site, in the vicinity of trucking movements, will be analysed for ACM or other waste excavated on-site to ensure that no transport of contaminated material is occurring off-site.

It is possible that small quantities of unknown material will be encountered during excavations in both the ACM and chromate brick areas. On encountering material that needs to be investigated the following action will be taken.

- All works that relate to the material will be stopped and the materials will be inspected by the appointed safety, health and environment personnel.

- Earthmoving activities will be redirected to another area if it is considered that the discovered materials warrant special consideration.

- Samples of the material will be sent for analysis if identification and characterisation is required, and

- The material will be disposed of according to the analytical results received.

Alternatively, if it is important that the material be moved immediately, it will be transported to another secure location on-site and stored until the laboratory results become known. In this case the material will be treated as contaminated until proven otherwise.

4.10.2 Water

An on-site sedimentation and waste control system will be constructed prior to the commencement of remediation. The design will be such as to allow collection of settled fines. This sedimentation and waste control system will receive all water generated from stormwater collection, truck washing and dewatering activities on-site. Such an arrangement will ensure that no contaminated waters produced from on-site activities will escape into the surrounding environment.

Truck washing will be provided prior to trucks leaving the site, and wastewaters from this washing area will be pumped to the sedimentation and waste control system. This washdown area will be lined.

Site drainage will be diverted away from contaminated zones to minimise the amount of stormwater that will require disposal. This stormwater will discharge into either the Burswood or the Swan Portland Western Perimeter Drain. These will then be collected by the sump at the confluence of the two drains and pumped back to the clay pit lagoon. Alternatively, these waters may be diverted into the sedimentation and

waste control system to be constructed on-site. All discharges from the drain will be monitored during works.

Any contaminated water will be disposed of by evaporation or treatment. Contaminated sludges produced will be disposed of to landfill.

4.10.3 Dust

Specific dust management strategies have been discussed in Section 4.3.2. However general dust management throughout the site during works will include the following:

- wetting by sprays and hoses during demolition.
- water carts on site to wet areas undergoing excavation.
- close control of works by the contractor and supervising engineer to limit, where possible, the potential for dust generation. This will include controlling the extent of excavation.
- the use of windbreak fencing.
- stabilisation of areas after the completion of the works.
- monitoring of nuisance dust.

Dust emissions will conform to the relevant EPA Guidelines for windborne material from development sites.

4.10.4 Noise

During the decommissioning of the site noise and vibration may be generated by machinery and vehicles. To prevent this activity becoming a nuisance for nearby properties, the construction activity will be managed to minimise noise. Contractors will be obliged to meet the requirements of the Noise Abatement (Neighbourhood Annoyance) Regulations 1979.

The excavators and trucks involved in the excavation will be in good operating order with standard noise mufflers to ensure excessive noise is not generated. These machines will operate during day light hours between 0630 and 1700 hours Monday to Saturday.

The potential impact of any noise generated is considered minimal principally because surrounding landuses includes major roads, railways and light industrial activities.

SECTION 5
WORKER SAFETY

5.1 OVERVIEW

There are locations within the site which contain materials that have the potential to harm human health. As a result, the contractors performing the works will be required to prepare a site specific Occupational Health and Safety Plan. The likely content of such a plan is described below, and will be based on the Code of Practice for the Safe Removal of Asbestos, when dealing with ACM. The plan will be forwarded to the WorkSafe Western Australia for their information and advice. A version of this plan will be supplied to the Department of Environmental Protection to indicate the monitoring and safety requirements of handling contaminated materials, as many of these actions will also assist in the detection of potential environmental impacts.

The guidelines will apply to the following activities on-site:

- Excavation of the ACM material
- Excavation of the kiln brick material
- Handling of ACM, CKD, kiln bricks and potentially contaminated fill excavated from both excavation areas
- Handling and sampling of stockpiled materials
- Handling of wastewaters generated from any dewatering activities
- Transporting material off-site.

The main method of ensuring the health and safety of personnel will be to protect personnel against exposure to hazardous materials.

The degree of protection to be employed is determined by knowledge of:

- Contamination levels
- The effects from exposure
- The perceived level of risk associated with exposure to particular substances

In order to protect personnel, the elimination or limitation of exposure pathways is required. Measures to achieve this are outlined in the following sections.

5.2 HEALTH AND SAFETY MEASURES

It should be noted that not all of the measures proposed here may be necessary and that the actual measures implemented will be determined by the Project Safety Health and Environmental Engineer according to the nature of the material being dealt with by workers and the particular tasks to be undertaken by individual personnel. However, many of the measures will be normal practice throughout the excavation and handling process. The measures will include the following:

- Education and training prior to any site works to ensure that all personnel are aware of the nature of the materials on-site, the exposure risks, exposure routes, and the precautions to minimise both on-site exposure and the risks of transporting materials off-site.

- Site personnel monitoring will be carried out from the initial stages to the completion of works in order to assess levels of exposure, and to ensure that health and safety measures are effective. The exposure limits for ACM, as given in the Code of Practice for the Safe Removal of Asbestos, will be used.

- Responsibility and management of personal health and safety will be clearly defined for all personnel. The rules will be strictly observed in the same manner as other health and safety matters such as wearing hard hats and ear defenders.

- Supervision will be carried out by the Project Safety Health and Environment Engineer who will be on hand to give advice, to take samples of any stockpiles and in the immediate excavation zone.

- Areas known to contain contamination will be marked as 'Contaminated Zones' using tape. Only authorised personnel will work in contaminated zones, and only under supervision wearing the appropriate safety equipment. ACM zones will be marked with the appropriate health risk warnings, according to the Code of Practice for the Safe Removal of Asbestos.

- Personnel will be required to wear overalls, gloves, boots, helmet and safety glasses wide side shields or goggles/face visor at all times when working in contamination zones. Available protective clothing will include all-in-one disposable suits which can be disposed of at the end of each shift.

- The controlled application of water using fine sprays will be used to prevent the generation of dust from materials within the ACM zones. Particular attention will be paid to this issue whilst excavating the ACM area.

- Dust masks, respirators and breathing apparatus will be supplied for workers working in both the ACM and chromate brick areas. They will be such as to ensure screening of the finest asbestos fibres, and will be properly fitted and tested to ensure no leakage occurs. These will satisfy the requirements in the Code of Practice for the Safe Removal of Asbestos.

- Respirators will be provided with the appropriate filter.

- Operators of mobile plant will be required to keep doors and windows closed and remain in the cab while in contaminated zones.

- On leaving the contamination zone, personnel will be required to change in a decontamination area where showers and lockers are provided. All protective clothing will be placed in the decontamination area for disposal or cleaning, depending on the types used.

- Separate eating areas away from contaminated zones will be provided.

- Eating, drinking, smoking and application of cosmetics will be strictly prohibited within and near contamination zones.

- An emergency shower and eye wash point will be nearby on-site in case of emergencies.

- An emergency response plan will be drafted which will include action thresholds for protection from contaminants, chains of command including contact names and telephone numbers, and emergency response to potential events.

- Dust monitoring will be carried out using personal samplers, measuring total dusts over an eight hour working period. These are attached to the workers lapel, near the breathing zone, and are run from a small pump. The need for personnel to wear these will depend on the particular task assigned to them and their predicted exposure level. At least one of the site personnel whose duties reflect a normal working day and a typical exposure pattern will be chosen for monitoring purposes. In addition a worker involved in excavation of the ACM may also be chosen.

- Site air quality monitoring will be carried out to monitor for asbestos particulates. The method of monitoring will conform to the criteria expressed in the Code of Practice for the Safe Removal of Asbestos.

5.3 PROJECT SAFETY HEALTH AND ENVIRONMENT ENGINEER

To ensure that works are undertaken in the manner outlined in this document, a Project Safety Health and Environment Engineer will be appointed. The presence of the Project Safety Health and Environment Engineer shall be dictated by the works in progress.

The Project Safety Health and Environment Engineer will have the authority to direct work, including stoppages, as and when contaminated material is encountered and therefore will work in close conjunction with the Site Engineer. All advice and lines of communication will be through the Site Engineer, however, should the Project Safety

Health and Environment Engineer observe work practices that may endanger health and safety, or that may represent a potential environmental hazard then direct communication to the agent/contractor will be required.

The tasks for the Project Safety Health and Environment Engineer will be as follows.

- Provision of advise on the identification, handling and disposal of contaminated materials.
- Be responsible for administering the contaminated soils consignment system documents.
- Recording of day to day events and regular inspection of operations in the form of a Record of Decision (ROD) in line with quality assurance and quality control procedures.
- Recording of volumes of material and chemical analysis with descriptions of materials removed and redeposited off-site as part of the ROD.
- Ensuring that all plant working in contaminated areas is clean prior to movement out of contamination zones in order to prevent transfer of contaminants to clean areas.
- Sampling to ensure the correct handling, removal and placement of all materials is carried out.
- To give advice and act on sampling and analytical results as and when they arise.
- To monitor site boundaries for dust generation, particularly the movement of asbestos dust, and report the results to the Site Engineer.
- To advise the Site Engineer regarding occupational health and safety guidelines during the construction works and provide a point of contact with WorkSafe WA.

SECTION 6
CONCLUSIONS

This Public Environmental Review (PER) describes a proposal to decommission the cement manufacturing works at Burswood owned by Swan Portland Cement Limited. The PER describes the environmental issues associated with this work and how these will be addressed. Section 7 describes the commitments made by the proponent regarding the management of the site during the works and in the long term.

The proponent, Swan Portland, considers that this proposal will have a positive impact on the environment by appropriately disposing or treating material that could compromise the future use of the site. This will allow the development of the site for uses that are appropriate for an inner city location. The environmental management proposed in this document will ensure that these works will be carried out safely and with no significant impact to the environment.

SECTION 7
COMMITMENTS

The proponent, Swan Portland Cement, is committed to ensuring that the decommissioning of the Burswood site is performed in an environmentally responsible manner. As such it makes the following commitments.

1. The removal of all asbestos contaminated material will be performed in accordance with the Code of Practice for the Safe Removal of Asbestos and the management techniques described in this PER. The proponent will liaise with WorkSafe WA in preparing a works programme for this work.

2. An air monitoring programme will be performed before, during and after works to monitor asbestos dust. Details of the monitoring programme will be included in the works programme forwarded to WorkSafe WA and the Department of Environmental Protection prior to commencement of works.

3. All materials transported from the site will be carried in appropriately equipped and labelled trucks in a manner consistent with the relevant codes that relate to the transport of the material.

4. The ultimate destination of all waste materials will be selected on the basis of criteria set by the Division of Waste Management of the Department of Environmental Protection. The proponent will consult with the Department of Environmental Protection during the selection process.

5. Water, dust and noise discharges from the site will be kept within the relevant criteria set by the Department of Environmental Protection during the implementation phase of the project. The proponent will monitor discharges from the site to confirm that these criteria are met. Breaches of these criteria will be reported to the Swan River Trust or Department of Environmental Protection.

6. Areas of the site containing cement kiln dust will have a cover of at least 0.5 m of fill material. This will be done as part of the recontouring of the site to enable construction to commence.

7. All stormwaters generated from the site will be collected and piped to the Swan River via a reticulated system. This will be done as part of the construction phase of the project.

8. Groundwater quality and watertable levels will be monitored during and after works to confirm the predictions described in the PER. Results of this monitoring will be reported to the DEP upon completion of works, and thereafter, during the post implementation phase.

9. A suitably qualified organisation will be retained by the proponent as an independent third party to advise on the success of the decommissioning in meeting the conditions

of approval for this project. Personnel from this organisation will check by monitoring, or any other method appropriate, conformance to these conditions.

10. A report will be prepared at the completion of the decommissioning which will provide evidence of conformance to the commitments and ministerial conditions set for the project. This report will be provided to the Department of Environmental Protection and Swan River Trust.

SECTION 8
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ABBREVIATIONS

ACM	Asbestos Containing Material
AHD	Australian Height Datum
CKD	Cement Kiln Dust
EPA	Environmental Protection Authority
GPR	Ground Penetrating Radar
LAC	Landfill Acceptance Criteria
MRD	Main Roads Department
PER	Public Environmental Review
R60	Permits Residential Unit Development at the Rate of 60 units per hectare
SEC	State Energy Commission
SPWPD	Swan Portland Western Perimeter Drain
TCLP	Toxicity Characteristic Leaching Procedure
UST	Underground Storage Tank

APPENDIX A

CONTAMINATED SITE - SWAN PORTLAND CEMENT, RIVERVALE

GUIDELINES FOR THE PUBLIC ENVIRONMENTAL REVIEW

Introduction

The Environmental Protection Authority (EPA) understands that this proposal is to decommission the existing cement works presently operated by Swan Portland Cement Ltd in Rivervale, and remediate areas of the site which have been contaminated as a result of past disposal practices undertaken by the company. Following cleanup, the site is planned to be re-developed for high density residential purposes.

Overview

All environmental reviews have the objective of protecting the environment, and environmental impact assessment is deliberately a public process in order to obtain broad ranging advice. The review requires the proponent to describe the proposal, receiving environment, potential environmental impacts and the management of the issues arising from the environmental impacts, so that the environment is protected to an acceptable level.

If the proponent can demonstrate that the environment would be protected from unacceptable environmental impacts, then the proposal would be found environmentally acceptable; if the proponent cannot demonstrate this, then the EPA would recommend against approving the proposal.

Throughout the assessment process it is the objective of the Department of Environmental Protection (DEP) to assist the proponent to improve the proposal such that the environment is protected in the best manner possible. The DEP will co-ordinate relevant government agencies and the public in providing advice about environmental matters during the assessment of this proposal.

These guidelines are issued to assist in identifying matters that should be addressed within the PER document. They are not exhaustive and other relevant issues may arise during the preparation of the document; these should also be included in the document.

Purpose of the PER

- To communicate clearly with the public and government agencies, so that the Environmental Protection Authority (EPA) can obtain informed comment to assist in providing advice to government;
- To describe all aspects of the proposal adequately, so that the Minister for the Environment can consider approval of a well-defined project; and
- To provide the basis for the environmental management programme, which should demonstrate that the environmental issues resulting from the proposal can be acceptably managed.

Objectives of the proponent's document

The PER should have the following objectives:

- to place this proposal in the context of the local and regional environment;

- to explain the issues, decisions and feasibility alternatives which led to the choice of this proposal at this place and at this time;

- to set out the specific environmental impacts that the proposal may have; and

- for each impact, to describe how the proponent would avoid, mitigate or ameliorate that impact.

The PER should focus on the key environmental factors for the proposal and anticipate the questions that members of the public may raise. Data describing the environment should be directly related to the potential impacts of the proposal. The discussion should then relate directly to the actions proposed to manage those impacts.

Contents of the proponent's document

The contents of the proponent's document should reflect the objectives outlined above.

The language used in the body of the document should be kept simple and concise, considering the audience includes non-technical people, and any extensive, technical detail should either be referenced or appended. The document will form the legal basis of the Minister for the Environment's approval of the proposal and, hence, should include a description of all the main and ancillary components of the proposal, including options if necessary.

The fundamental contents of the proponent's document should include, but not be limited to the following:

- introduction of the proponent, the project and location, including cadastral information;

- the legal framework, decision making authorities and involved agencies;

- description of the components of the proposal and identification of the potential environmental impacts. This information should be described in the form of a summary table which describes the key characteristics of the proposal;

- description of the receiving physical, biological and human environment which may be impacted;

- discussion of the key environmental factors (shown in the next section), including an assessment of their significance in comparison to relevant objectives, policies or standards;

- discussion of the management of the issues, including commitments to appropriate action; and

- a summary of the environmental management programme, including the key commitments, monitoring work and the auditing of the programme.

The EPA considers that environmental management is best approached in terms of best practice, which can include:

- an overall objective to reduce as far as practical all potential impacts on the environment.

- development of an environmental policy;

- agreed environmental objectives;

- management practices to achieve the objectives;
- involve the public as appropriate;
- audit environmental performance against agreed indicators;
- regular reporting to the EPA (or nominated agency);
- commitment to a quality assured management system and continuous improvement; and
- periodic review (for example 5 yearly) in conjunction with the EPA (or nominated agency).

Additional content requirements for the proponent's document are included in the next section.

Key environmental factors

The key factors can be determined from a consideration, called scoping, of the potential impacts of the proposal on the environment. The receiving environment includes social surroundings.

The proponent's document should focus on the key factors for the proposal as agreed in consultation with the DEP and relevant government agencies. A description of the project component and the receiving environment should be directly included with, or referenced to, the discussion of the topic. The technical basis for measuring the impact and any objectives or standards for assessing and managing the factor should be provided.

The proponent should provide a table which describes the following:

(a) the present state of the environment;

(b) potential impacts of the proposal on the environment;

(c) nominate environmental management objectives(s) for those aspects which require management;

(d) environmental management response to manage impacts to meet the above objective(s); and

(e) envisaged state of the environment if and when the management objectives are met.

The factors from which the key environmental issues are derived (and their corresponding objectives) at this stage should be set out under the following categories, where relevant:

- biophysical issues;
- pollution issues; and
- social surroundings issues.

Key environmental factors identified, and the EPA's management objective for these factors have been listed in the table below. Items in **bold** represent the factors relevant to the project which the EPA are likely to report on to the Minister for the Environment.

Factors	EPA's Environmental Objective	
POLLUTION MANAGEMENT		
Rehabilitation	To ensure the rehabilitation of the impacted area to an acceptable standard that is compatible with the intended land use.	The EPA has recognised that for rehabilitation to be most effective it must be implemented early into the operating plans. It is of paramount importance to the State that rehabilitation management does not impose short or long term costs on the community of Western Australia.(812)
Water quality Surface water quality	To maintain or improve the quality of surface water to ensure existing and potential uses are protected.	Meet the requirements of the draft Western Australian Water Quality Guidelines for Fresh and Marine Waters (EPA Bulletin 711). Land use which could lead to the unacceptable deterioration of surface water quality should not be permitted over areas set aside for public water supply.
Ground water quality	To maintain or improve ground water quality.	Meet the requirements of the draft Western Australian Water Quality Guidelines for Fresh and Marine Waters (EPA Bulletin 711). Land use which could lead to the unacceptable deterioration of ground water quality should not be permitted over areas set aside for public water supply.

Dust	**To protect the surrounding land users such that dust emissions will not adversely impact upon their welfare and amenity or cause health problems.**	**The EPA Guidelines for Assessment and Control of Dust and Windborne Material from Land Development Sites, updated 1995.(785) Environmental Protection Policy (Atmospheric Wastes) (Kwinana), the EPA base environmental acceptability on NH&MRC, VEPA, USEPA, and WHO criteria.(794)**
Noise and vibration	**To protect the amenity of nearby residents from noise and vibration impacts resulting from activities associated with the proposal by ensuring that noise and vibration levels meet statutory requirements and acceptable standards.**	**To meet the criteria in the Noise Abatement (Neighbourhood Annoyance) Regulations 1979 and the proposed Environmental Protection (Noise) Regulations (when promulgated) and any policies covering noise or vibration which have been endorsed by the EPA.(808)**
Contingency plans	Ensure contingency measures are in place in the event monitoring reveals exceedances in stipulated water quality guidelines (eg ANZECC/NHMRC water quality guidelines) on surface or groundwater due to export of contaminants from site.	
SOCIAL SURROUNDINGS		
Import of clean fill.	Ensure that impacts related to the import of clean fill do not affect public amenity.	

The proponent's document should also include, but not be limited to, the following:

- Definition of existing surface infrastructure, and information on previous investigations on the geology, and hydrogeology (surface and sub-surface) of the site in light of environmental impacts from past, existing and proposed activities at the site;

- **Identification of the location(s), depth, estimated quantities and chemical and physical characteristics of contaminants at the site and adjacent drains and waterways. Reference should especially be made, but not limited to, the following contaminants:**
  - **asbestos cement products and loose asbestos fibres (compliance with 'Worksafe guidelines for removal of asbestos cement building products, November 1995);**
  - **alkaline cement kiln dust;**
  - **chromate bricks; and**
  - **hydrocarbon drums/oil waste.**

- Methodology for defining the location, types, and concentrations of buried contaminants and its relationship to present soil stratigraphy;

- Outline of sampling methods and results of analyses undertaken prior to cleanup;

- **Proposed remediation methods for contaminants identified on-site** and sequence of remediation of each zone;

- **Method of treatment of contaminants proposed to be left in-situ, including proposed monitoring provisions;**

- Identification and management proposed for existing fuel storage tanks;

- Identification of appropriate cleanup criteria which is consistent with criteria for proposed future land use(s) at the site;

- Description of methodology to verify effectiveness of the clean-up;

- **Identification of existing groundwater quality and location of contaminant plumes, potential impacts on groundwater during cleanup and proposed treatment and/or ameliorative measures during and following cleanup operations to prevent further contamination of groundwater;**

- **Identification of existing and potential impacts on Swan River during and following cleanup operations;**

- Risk assessment to identify pathways whereby contaminants may threaten the life of future site residents and the local environment (in accordance with ANZECC Contaminated Sites Guidelines, 1992). Consideration should be given to re-contouring the site for development purposes, installation and maintenance of below ground services and environmental impacts from any barrier designed to isolate contaminated matter not removed from the site.

- Management of stockpile of sludge materials removed from Burswood Drain and the lagoons and identification of pollutants, their quantities and proposed treatment;

- **Proposed earth moving methods and methods for the control of dust, noise, vibration and light spill during cleanup operations;**

- Outline of methods for servicing and protection and/or relocation of existing services, and impact on the environment;
- Describe proposed methods for treatment of existing sewerage and stormwater drainage at the site;
- Outline of rehabilitation proposals for disturbed areas including stabilisation, landscaping, types of native vegetation cover and the management of future drainage from the area;
- Proposed future use of the clay pit lagoon and holding dam;
- Proposed methods for off-site disposal;
- Identification of suitable landfill site(s) (with appropriate approvals from relevant agencies/authorities) which can accept material being disposed of off-site;
- Brief outline of community consultation undertaken by proponent during the preparation of the PER;
- Brief outline of potential health implications of contaminants on-site; and
- Outline of occupational safety and health issues covered by the Occupational Safety and Health Act and Regulations (1996) such as information, training, supervision, personal hygiene and consultation. A section may be included which addresses measures that will be taken to reduce exposure of employees to hazards to below Occupational Exposure Standards and/or the provision of personal protective equipment and clothing, and the appropriate training in its use, maintenance and storage.

Further key issues may be raised during the preparation of the proponent's document, and on-going consultation with the DEP and relevant agencies is recommended. Minor issues which can be readily managed as part of normal operations for similar projects may be briefly described. Information used to reach conclusions should be properly referenced, including personal communications. Assessments of the significance of an impact should be soundly based rather than unsubstantiated opinions, and the assessment should lead to a discussion of the management of the issue.

Public consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent in preparing the document. It should describe the activities undertaken, the dates, the groups/individuals involved and the objectives of the activities. Cross reference should be made with the description of environmental management of the issues which should clearly indicate how community concerns have been addressed. Those concerns which are dealt with outside the EPA process can be noted and referenced.

If additional information (eg project design, field surveys) is to be provided at a later date, the process by which the public review of this information will be facilitated, should be documented.

Environmental management commitments

The method of implementation of the proposal and all commitments made by the proponent in the document will become legally enforceable under the environmental conditions of the Minister for the Environment's approval. Specific commitments to protect the environment, typically related to the key issues, should be separately listed, numbered and take the form of:

- who would do the work;

- what the work is;
- when the work would be carried out; and

- what agencies would be involved.

Other commitments show that the proponent is dedicated to good environmental management of the project, and the DEP expects that the proponent will audit these commitments by internal processes under an Environmental Management System. Though not subject to routine audit, the DEP may request that compliance with, or the in-house audit of, these commitments be demonstrated, so as to verify satisfactory environmental performance. The commitments define the goals/objectives for the environmental management programme and procedures (the details of how the commitment will be met), which should be described in as much detail as possible. The DEP acknowledges that, with the implementation of best practice and continuous improvement for the project, the procedures may need to be modified, or added to, in regular updates to the environmental management programme.

Note:

- The first page of the proponent's document must be an invitation to make a submission, an example of which is provided on the next page. It should include why and how to make a submission; and the use made of submissions as detailed on the attached example.

- These guidelines for preparation of the document should be included as an appendix to the document.

INVITATION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

The document describes a proposal to decommission the existing cement works presently operated by Swan Portland Cement Ltd. in Rivervale, and remediate areas of the site which have been contaminated as a result of past disposal practices undertaken by the company. Following cleanup, the site is planned to be re-developed for high density residential purposes. In accordance with the Environmental Protection Act, the document has been prepared to describe this proposal and its likely effects on the environment. The document is available for a public review period of 4 weeks from _____ 1996 closing on _____ 1996.

Comments from government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to the Minister for the Environment.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in each report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the document or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the document:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the document;
- if you discuss different sections of the document, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name,
- address,
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: ____ **1996**

Submissions should be addressed to:

The Chairman
Environmental Protection Authority
Westralia Square
141 St George's Terrace
PERTH WA 6000

Attention: **Mr Henk Van der Wiele**

APPENDIX B

APPENDIX B
CEMENT KILN DUST

INTRODUCTION

CKD has been identified by the US EPA as a large volume, low hazard material which in recent years has been viewed by portland cement factories as a potential resource (Abeln *et al*, 1993). It can be used as a liming material for agriculture, and as a lime substitute.

The composition and concentration of metals in CKD is variable depending on the extent of CKD recirculation and its volume. The levels of metals in raw materials and fuels is largely of secondary importance. However, the recyclability of CKD will also vary depending on water leaching through the CKD and its effectiveness in reducing alkali levels.

The composition of CKD is also influenced by its age. Special characteristics of CKD, such as water retention and chemical reactivity in the presence of moisture, would vary depending on whether the CKD is fresh or has been stockpiled for a number of years. Stockpiled CKD at the Swan Portland Cement varies in depth and age.

CKD AND THE CEMENT INDUSTRY

CKD is generated within all cement kilns. All producers attempt to recycle but they are limited by the process and/or the chemical composition of the CKD:

- Process limits are related to the type of kiln used, 100% recycling is easy on modern preheater kilns, however 100% is often impossible on wet process kilns as used by Swan.

- Chemical limits are related to factors such as alkali or chloride build up causing internal blockages.

Swan recycle approximately 80% of the CKD. Further recycling is limited because the wet process is used.

Increased awareness of environmental issues means cement plants are having to demonstrate the safeness of their CKD before disposal or off-site use (Wolfe, 1991). Disposal to landfill is the most commonly used waste management option, however, CKD is sometimes sold as fertiliser or liming agent.

CKD AT SWAN PORTLAND

The 70 year presence of the Swan Portland facility has coincided with production of a significant amount of CKD which has been disposed of over the western portion of the site. Ground surface contours conducted in 1989 indicate that up to 10 m of fill has been placed in some parts. It is understood that the precipitator material was allowed to run off along the

surface to be retained by small dykes which were progressively positioned around the site as the elevation of the fill increased.

The clay pit, which dates back to aerial photographs from 1953, contains CKD which is estimated to occur approximately 10 m below the watertable. The clay pit has been progressively filled over the past few decades with precipitator material which was disposed of underwater.

The current employee car park also overlies an area which has been filled with CKD material.

CKD CHEMICAL AND PHYSICAL PROPERTIES AT SWAN PORTLAND

Monitoring of the composition of CKD has been routinely undertaken by Swan Portland over the last decade. Table 1 below provides the results of the analysis of the average composition of CKD from Swan Portland's plant.

TABLE 1
Typical Analyses of Cement Kiln Dust

Date	Constituent Percentage by Mass					
	SiO_2	Al_2O_3	Fe_2O_3	CaO	Loss on Ignition	Others*
1982	14.2	3.4	3.0	49.6	25.0	4.8
1983	13.3	3.7	2.9	48.0	26.0	6.1
1984	13.2	3.8	3.1	46.0	27.0	6.9
1985	14.0	3.6	2.9	47.2	26.7	5.6
1986	13.9	3.7	3.3	47.0	27.1	5.0
1987	12.4	2.9	2.9	50.0	29.1	2.7
1988	12.2	2.4	3.1	47.6	28.5	6.2
1990	12.6	3.1	3.0	47.1	28.3	5.9
1991	12.2	3.0	3.1	44.4	30.3	7.0
Mean ± S.D	13.1±0.8	3.3±0.5	3.0±0.1	47.4±1.7	27.6±1.6	5.6±1.3

(* Others includes MgO, Na_2O and K_2O)

As indicated in Table 1, the composition of CKD has varied little over the years of cement production at Swan Portland's site and its composition can be considered 'uniform'. This is to be expected as the materials and processing required for cement manufacturing have not altered. Therefore current elemental analysis of CKD will be reflective of the elemental composition of past CKD buried on Swan Portland's site. No significant variance is expected either with depth, or laterally. 'Age' could not be inferred from any particular elemental dominance or paucity.

CKD is strongly hydrophilic. On addition of water, hydration products are formed, resulting in the CKD hardening under oxidising conditions. Typical compressive strengths in excess of 3.45 Mpa (500 psi) have been recorded when CKD is cured for seven days in a closed container with free water. The addition of 10 to 15% water by weight results in CKD forming a 'sticky' sludge which prevents dusting of the material.

A large surface area is available within CKD due to its fine particle size. As water moves into the interstitial pore space between the particles within CKD, surface interactions between the water and the CKD binds the water. Kiln dust will retain 40 to 50% of its weight in water before reaching saturation. Due to this surface tension CKD has very low permeabilities under saturated conditions. Permeabilities of 10^{-6} cm/second (ca. 10^{-3} m/day) are average values recorded. These also typify the permeabilities for strong clays.

ANALYSIS OF HEAVY METALS AND LEACHATE METALS IN SWAN PORTLAND'S CEMENT KILN DUST

Metal concentration in kiln dust and the cement product originate from the raw materials and fuels used in the plant. The composition being determined by design and operational practices of the kiln.

Studies by Ove Arup and Partners (1993) indicated that the more volatile metals (mercury, selenium, thallium, lead and antimony) tend to concentrate in the CKD (Table 2). In the kiln, which reaches approximately 1480°C, volatile metals will not only melt, but boil and become part of the exhaust gases. Upon cooling of these gases, volatile metals within the emissions condense on particle surfaces and are not emitted with the exhaust gases. These particles are subsequently captured by the electrostatic precipitators and disposed within the CKD.

The degree of concentration of volatile metals is related to the recirculation of CKD within the process operation. That is, the higher the percentage of CKD recycled to the process, the greater the tendency for volatile metals to concentrate.

The Portland Cement Association data in Table 2 shows the range in metal concentrations for a variety of kiln types and raw materials.

TABLE 2
Total (acid soluble) metal levels in Cement Kiln Dust
(mg/kg dry weight)

Parameter	Detection Limit	Swan Portland *			Dutch Criteria			Portland Cement Association	
		1	2	3	A	B	C	Min	Max
As	0.005	10	5.8	1.15	20	30	50	2.0	159
Hg	0.005	0.06	<0.05	0.005	0.5	2	10	0.004	25.5
Se	0.005	<0.5	<0.5	0.05	-	-	-	2.68	307
Sn	5	-	-	<	20	50	300	-	-
Cd	0.25	0.5	<0.05	0.4	1	5	20	0.1	59.6
Ca	0.01	-	-	17.2%	-	-	-	-	-
Cr	5	37	33	92	100	250	800	8	293
Co	5	-	-	-	20	50	300	-	-
Cu	2	-	-	4	50	100	500	-	-
Pb	5	18	12	38	50	150	600	34	7390
Mn	5	-	-	86	-	-	-	-	-
Ni	5	<5	<5	<5	50	100	500	1.0	60
Ba	-	350	360	-		400	2000	35	767
B	-	10	5	-	-	-	-	-	-
Ag	0.5	-	-	<	-	-	-	48	40-70
Zn	2	-	-	<	200	500	3000	-	-
Cr^{6+}	0.25	0.72	0.33	0.25	100	250	800	-	-
Mo	5	<3	<3	6	10	40	200	-	-

< - Below Detection Limit - no data
* results of 1 and 2 taken from Golder Associates briefing notes and 3 taken from Ove Arup

Source: Ove Arup and Partners, 1993 and Golder Associates, 1996

Wet process kilns, the type of kiln used by Swan, tend to show only a slight concentration of volatile metals in CKD and the Swan analyses are consistent with this tendency.

The refractory metals, chromium, beryllium, barium, nickel, arsenic and silver, have higher melting points, therefore at elevated kiln temperatures they tend to remain in the clinker. Thus, these metals accumulate in the cement product.

Results of an analysis of metal levels within CKD samples obtained from Swan Portland's operation are shown in Table 2. The composition of Swan Portland's CKD falls within the range recorded by the Portland Cement Association study. All metal levels, with the exception of barium, recorded within the CKD were below the Dutch A criteria 'background threshold' levels for soils.

As well as studies on the composition and metal concentration of Swan Portland's CKD, leach tests were carried out on Swan Portland CKD (Ove Arup and Partners, 1993 and Golder Associates, 1996). The results were compared to the Landfill Acceptance Criteria (LAC) used in WA to assess the suitability of wastes for a particular grade of landfill activity. The criteria are calculated as a multiple of the drinking water guideline for each parameter and are useful in determining the groundwater contamination hazard posed by a particular material.

- Class III LAC is leachate at less than 10 times the drinking water guidelines
- Class IV LAC is leachate at >10 times but <100 times drinking water guidelines

The results of these tests show no exceedance of the leachate composition acceptable for the lowest grade of landfill (Class III) and are shown in Table 3.

TABLE 3
Leachate (TCLP) Chemistry of Swan Portland CKD (mg/kg)

Parameter	Measurement (mg/kg)		Landfill Acceptance Criteria	
	Sample 1	Sample 2	Class III	Class IV
As	<0.05	<0.05	<0.07	<0.7
Cd	<0.005	<0.005	<0.02	<0.2
Cr	0.21	0.13	NA	NA
Cr^{6+}	0.15	0.08	<0.5	<5
Hg	<0.0002	<0.0002	<0.01	<0.1
Mo	<0.05	<0.05	<0.5	<5
Ni	<0.05	<0.05	<0.2	<2
Pb	<0.05	<0.05	<0.1	<1
Ba	2	2.2	<7	<70
B	<0.03	<0.03	<3	<30
Se	<0.002	<0.002	<0.01	<1

Source: Golder Associates, 1996

The laboratory leach tests modelled the worst case scenario of acidic soil moisture conditions.

The results of the level of metals and the leachate generated from the above tests (Tables 2 and 3) indicated that factors other than the concentration of total metals in CKD impact the amount of metals leached. Total metals concentrations are not reliable predictors of leachable metals concentrations. In relation to CKD deposited within Swan Portland's site, the chemical results from the Portland Cement study indicate that the minimum leachable metals recorded from cement kiln dust are below background levels for groundwater as stipulated, Dutch criteria guidelines. Leach tests carried out on Swan Portland Cement show no exceedance of the leachate composition acceptable for the lowest grade of landfill (Class III). Results therefore suggest that CKD at the site does not pose a contamination risk to groundwater in terms of heavy metals.

OTHER CKD STUDIES

In the United States, numerous studies on CKD have been undertaken in light of increased environmental awareness and the constant expansion of the regulatory influence of government.

Initial studies in 1982 analysed the mineralogical and chemical composition of CKD, and applied the US Environmental Protection Authority Extraction Procedure (EP) Toxicity Test. All but one sample were in compliance with the test, the non-complying sample slightly exceeded the EP toxicity test criteria for lead (Haynes and Kramer, 1982). This study was

updated in 1991, taking into account the changes in the manufacturing process, raw materials, fuels and testing procedures. Each CKD sample was evaluated using the US EPA toxicity characteristic leaching procedure. As was found in Swan Portland's study, samples containing the highest metals levels did not necessarily produce the highest TCLP result. The study used the EPA's "regulatory action levels" (or RCRA limits), for selected leachate metals. Overall, CKD did not exceed levels, with the exception of two cases which had high levels of selenium and lead. The elevated levels were attributed to the fact that relatively little CKD was discarded. Cement plants which discard a higher volume of CKD, tend to have a lower levels of TCLP (Haynes and Kramer, 1982), which may explain why Swan Portland's levels are within Landfill Acceptance Criteria.

Other studies in the US have addressed:

- permeability and compactions of CKD (Todres *et al*, 1992)
- the removal of impurities to increase the recycling potential of CKD (Wolfe, 1991+)
- modelling to stimulate water balance in CKD (Abeln *et al*, 1993)
- management practices for CKD (Abeln *et al*, 1993)

CONCLUSION

Studies of CKD at Swan Portland Cement and in the US found that although CKD represents a large volume of waste for the portland cement industry, overall it is inert and a low contamination risk. Levels of heavy metals and leachable components were found to be within relevant criteria.

Swan Portland Cement's results were within Dutch A criteria and suitable for disposal at the lowest grade of landfill. Studies in the US found all sampled CKD complied with toxicity tests for heavy metals and almost all samples complied with the TCLP.

APPENDIX B
REFERENCES

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APPENDIX C

APPENDIX C
KILN BRICKS

INTRODUCTION

Old kiln bricks which were used to line the kilns on the Swan Portland Cement site have been buried on site. Primarily buried under the employee car park, they have also been disposed of over various other parts of the site. The buried bricks may release chromate leachate which has the potential to contaminate groundwater.

STUDIES ON KILN BRICK WASTE

There have been several studies which have addressed the buried kiln bricks. In 1993 Ove Arup and Partners monitored for chromate and chromate related compounds, but found no evidence that chromate had contaminated groundwater. (Ove Arup and Partners, 1993).

A more recent study dug a trench to recover kiln brick waste which was mixed with cement kiln dust (CKD) and inert rubbish. Both total heavy metal composition and toxicity characteristic leaching procedure (TCLP) tests were conducted on an alumina brick, two chromate bricks, kiln coating material and soil from beneath the bricks (Golder Associates, 1996). The results are shown in Table 1 and 2.

Table 1 shows there is no exceedance of the Dutch B guideline values apart from total chromium in the chromate bricks, kiln coating and soil. Nickel in the chromate bricks slightly exceeded the ANZECC/NH&MRC investigation levels, but are below Dutch B criteria.

The leach test results shown in Table 2, were compared to the Landfill Acceptance Criteria (LAC). Levels of arsenic in the chromate brick and kiln coating exceeded Class III LAC. Class III LAC for Boron was exceeded for the other chromate brick sample.

DISCUSSION

Table 1 shows that the chromium content of the chromate bricks exceeds ANZECC/NH&MRC and Dutch C levels. However, the level of chromium leachate in TCLP tests was not very high. This may have been because of the following:

- any chromate bearing water that is generated from inflow cannot easily escape the kiln dust fill;
- chromate is present in small quantities. The Ove Arup and Partners (1993) study revealed boreholes which were thought to be near chromium bricks had 13 mg/l of chromium, which is low given the background levels are up to 100 mg/l;
- chromate is not in contact with groundwater, therefore is not being leached out. Chromate may still be leached from rainfall infiltration, however the car park capping may have prevented this from occurring;

- even if the bricks are in contact with the groundwater, the elevated pH levels will not result in the dissolution of chromate, therefore chromate may not be detected; and
- the movement of the chromate from the bricks has not been significant enough to be detected in the surrounding soil or groundwater. This is possible given the flow rates (gradients) are quite low.

CONCLUSION

Chromate contamination from the kiln bricks is low, and previous studies have not detected levels which have exceeded leachate criteria. It is therefore anticipated that any bricks that remain undetected on-site will not adversely impact upon the groundwater.

TABLE 1
Total Chemical Composition (mg/kg) for Kiln Brick Study

	Samples					Guidelines		
	Alumina Brick	**Chromate Brick Sample 1**	**Chromate Brick Sample 2**	**Kiln Coating**	**Soil**	**ANZECC/ NH&MRC Environmental Investigation Level**	**Dutch B Guideline (investigation level)**	**Dutch C Guideline (clean-up level)**
Arsenic (As)	1.1	1.6	1.8	9.1	7.1	20	30	50
Cadmium (Ca)	0.9	<0.05	<0.05	<0.05	<0.05	3	5	20
Chromium (Cr)	<5	2300	2000	640	280	50	250	800
Chromate (Cr^{6+})	0.06	0.05	8.5	15	2.6	NA	NA	NA
Mercury (Hg)	<0.05	<0.01	<0.05	<0.05	0.09	1	2	10
Molybdenum (Mo)	<3	<3	<3	<3	<3	NA	40	200
Nickel (Ni)	<5	84	73	<5	10	60	100	500
Lead (Pb)	6	<5	7	<5	19	300	150	600
Barium (Ba)	6	9	11	630	290	NA	400	2000
Boron (B)	<2	290	98	42	41	NA	NA	NA
Selenium (Se)	<0.5	<0.5	<0.5	<0.5	<0.5	NA	NA	NA

NA - Not Available

TABLE 2
Leachate (TCLP) Chemistry (mg/l) for Kiln Brick Study

	Samples					Guidelines	
	Alumina Brick	**Chromate Brick Sample 1**	**Chromate Brick Sample 2**	**Kiln Coating**	**Soil**	**Class III LAC**	**Class IV LAC**
Arsenic (As)	<0.05	<0.05	0.05	0.07	0.08	<0.07	<0.7
Cadmium (Ca)	0.017	<0.005	<0.005	<0.005	<0.005	<0.02	<0.2
Chromium (Cr)	<0.05	<0.05	2.5	4.7	<0.71	NA	NA
Chromate (Cr^{6+})	0.01	0.18	0.21	0.16	0.17	<0.5	<5
Mercury (Hg)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.01	<0.1
Molybdenum (Mo)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<1
Nickel (Ni)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<2
Lead (Pb)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<1
Barium (Ba)	<0.1	<0.1	0.58	2.6	2.3	<7	<70
Boron (B)	<0.03	3.5	0.5	<0.03	0.13	<3	<30
Selenium (Se)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.1	<1

NA - Not Available

APPENDIX C
REFERENCES

Golder Associates (1996). Swan Portland Cement Site Containment Management. Briefly Notes for 4th April 1996.

Ove Arup and Partners (1993). Swan Portland Cement. Site Contamination Assessment. A Preliminary Study to Determine the Contamination of the Swan Portland Cement Site, Rivervale, May 1993.

APPENDIX D

APPENDIX D
WATER MONITORING RESULTS
(DRAINS AND GROUNDWATER)

INTRODUCTION

Several studies have taken place at Swan Portland Cement which have investigated water quality in the drains on the western edge of the site and the groundwater under the site which moves in a westerly direction.

Groundwater moving under the site intercepts Swan Portland's Western Perimeter Drain (SPWPD). The drain then connects with the Burswood Drain which then discharges to the Swan River. Thus any contamination in the groundwater will enter the SPWPD, which in turn will enter the Swan River.

GROUNDWATER AT SWAN PORTLAND

The groundwater under the Swan Portland site has had the potential to be contaminated from years of plant activity. Groundwater recharge comes from numerous sources on the site, including rainfall and irrigation water, as well as water seeping through the base of existing ponds (AGC Woodward-Clyde, 1990).

STUDIES OF GROUNDWATER QUALITY

The earliest study of groundwater, was in the Burswood region, and not specifically on the Swan Portland site. These studies between 1978 and 1985 addressed salt water intrusion and groundwater recharge of the Burswood Peninsula (Riggert Consulting Ecologists, 1985).

Several subsequent studies on water at the site concerned the drains. Although this is interlinked with groundwater these will be discussed in the next section.

The next reports which specifically addressed groundwater under the Swan Portland Cement site were conducted by Golder Associates and Ove Arup and Partners. The aim of these reports was to:

- assess groundwater quality at the site; and
- identify corrosive or aggressive environments below ground level that would require special precautions applicable to foundations and buildings (Golder Associates, 1993)

Golder Associates (1993) were primarily responsible for field testing and establishing groundwater monitoring installations. Ove Arup and Partners (1993) were responsible for the organisation of chemical testing and interpretation of these results.

Golder Associates (1993) conducted a geotechnical investigation which included:

- drilling of boreholes and construction of groundwater monitoring installations
- monitoring bore development and measurement of groundwater levels

Groundwater levels for the overall site indicated that:

- the groundwater level at the western boundary was generally about RL 2.
- the groundwater level at the eastern boundary was generally about RL 3.5.
- the groundwater mound from the clay pit lagoon had a maximum elevation of around RL 5.5.

The Ove Arup and Partners study (1993) studied more than groundwater levels. The sampling and analysis strategy for this study was to:

- install some groundwater monitor bores to obtain samples that would represent general groundwater quality across the site;
- analyse the water for priority pollutants and use the groundwater samples from the investigative bores for chemical analysis;
- describe the potential contamination on the site, where it is coming from and where it is going to and its significance; and
- describe the constraints and opportunities to redevelop the site.

The study did not fully determine depth, quality and flow velocity of the groundwater. It also did not determine if any buried material was in contact with the groundwater and whether this generated contaminated leachate. (Ove Arup and Partners, 1993)

To assess the potential contamination the study needed to be able to compare results to a standard. There were no Western Australian, State or National criteria for contamination of groundwater therefore the groundwater data was compared to international criteria. The Dutch C criteria for groundwater was selected as an appropriate criteria. Only one of the parameters sampled exceeded the criteria and was considered to be contaminated. One of the monitor bores recorded zinc levels of 0.87 mg/l, 0.07 mg/l above the criteria for zinc. No organic analyses exceeded any of the Dutch C criteria levels. (Table 1).

TABLE 1
Comparison of Groundwater Results to Dutch Criteria

Parameter	Groundwater		
	No of Samples Analysed	No of Samples Greater than Detection Limit	No of Samples Exceeding the Dutch C Criteria
METALS			
As (Arsenic)	3	1	0
Ag (Silver)	3	0	NCS
Ca (Calcium)	3	3	NCS
Cd (Cadmium)	3	0	0
Co (Cobalt)	3	0	0
Cr (Chromium hexavalent)	3	0	NCS
Cr (Chromium total)	3	0	0
Cu (Copper)	3	3	0
Fe (Iron)	3	4	NCS
Hg (Mercury)	3	0	0
Mn (Manganese)	3	3	NCS
Mo (Molybdenum)	3	0	0
Ni (Nickel)	3	1	0
Pb (Lead)	3	1	0
Se (Selenium)	3	0	NCS
Sn (Tin)	3	0	0
Zn (Zinc)	3	2	1
INORGANIC POLLUTANTS			
Total Cyanide	3	0	0
PHYSICAL PARAMETER			
pH	3	3	NCS
ORGANICS			
AROMATIC COMPOUNDS			
Benzene	3	0	0
Ethylbenzene	3	0	0
Toluene	3	0	0
Xylene	3	0	0
POLYCYCLIC HYDROCARBONS			
Total Hydrocarbons	3	0	0

No Dutch criteria existed for pH levels, therefore the pH of the groundwater was compared to other international criteria. The pH exceeded the criteria. The results were consistent with earlier studies by Dames and Moore (1991a, 1991b) which found the groundwater which was discharging into the drains was alkaline. The high alkalinity and possibly the potassium content may make the groundwater corrosive which has implications for handling the groundwater. Golder Associates (1993) recognised that the potassium content of the buried cement kiln dust (CKD) has the potential to exacerbate the alkaline nature of the groundwater.

Results of the pH are shown in Table 2. Monitoring bore 2 was alkaline. The study attributed the neutral pH of monitoring bore 1 to the drainage waters in the Burswood Drain seeping into the monitoring bore. (Ove Arup and Partners, 1993)

TABLE 2
pH of Groundwater

Groundwater Monitor Bore	pH
1	7.2
2	12.6
3	9.6
4	9.0

In 1994, two reports were once again released by Golder Associates (1994) and Ove Arup and Partners (1994). Golder Associates (1994) report was concerned with the installation of monitoring bores, groundwater sampling and permeability testing. The objectives included:

- drilling boreholes and installing monitoring bores
- determining surface and ground water levels in the bores
- performing permeability tests of bores
- sampling groundwater in all bores
- sampling groundwater in sections of the open drains
- carrying out chemical testing of groundwater from all bores, including pH, Total Dissolved Solids, HCO_3, major anions and cations, sulphate and chloride
- reporting results of field and laboratory studies

Ove Arup and Partners (1994) used the wells created by Golder Associates (1994) to fully investigate the impact of Swan Portland Cement on the drains. Groundwater issues were included and a remedial management plan to mitigate future impacts was proposed.

A 1995 Ove Arup and Partners document later addressed the environmental and health impacts of the groundwater, especially if water is extracted and used on or adjacent to the site. It was also noted that it may be possible to demonstrate that dilution or other factors may off-set the impacts, particularly on the Swan River.

Currently Golder Associates are monitoring groundwater (as well as drains) as part of a larger contamination management and remediation strategy for the redevelopment of the Swan Portland site (Golder Associates, 1996b).

Groundwater levels were monitored in January and February 1996. Depths ranged from 1.59 to 6.6 metres below ground level. Table 3 shows that between 1994 and 1996 groundwater levels decreased by approximately one metre.

TABLE 3
Groundwater Elevation Data Between 1994 and 1996

Date	MB1 (m)	MB2 (m)	MB3 (m)	MB4 (m)	MB5 (m)	MB6 (m)	MB7 (m)	MB8 (m)
8-3-94	1.93	1.1	2.43	2.76	4.48	1.08	1.1	1.34
22-11-95	1.55	1.09	-	-	4.14	0.95	0.89	1.62
25-1-96	1.58	1.00	2.4	2.73	3.99	0.98	0.89	1.17
14-2-96	1.34	0.72	1.91	2.67	3.52	0.48	0.57	0.6
28-2-96	1.3	0.7	1.45	2.46	3.46	0.39	0.15	0.49

MB - Monitoring Bore

DRAINS AT SWAN PORTLAND CEMENT

The two major drains on the Swan Portland site are the SPWPD and the Burswood Drain. As previously noted, they lie on the western perimeter of the site, before converging, diverting east and discharging into the Swan River.

Water enters the SPWPD from both surface water and groundwater. The surface water is primarily run-off, and because the base of the drains lies below the groundwater level, groundwater from the Swan Portland site continually enters the drain. The Burswood Drain collects water from run-off and groundwater not only from the Swan Portland site, but land to the north and west of the site.

STUDIES OF DRAIN WATER QUALITY

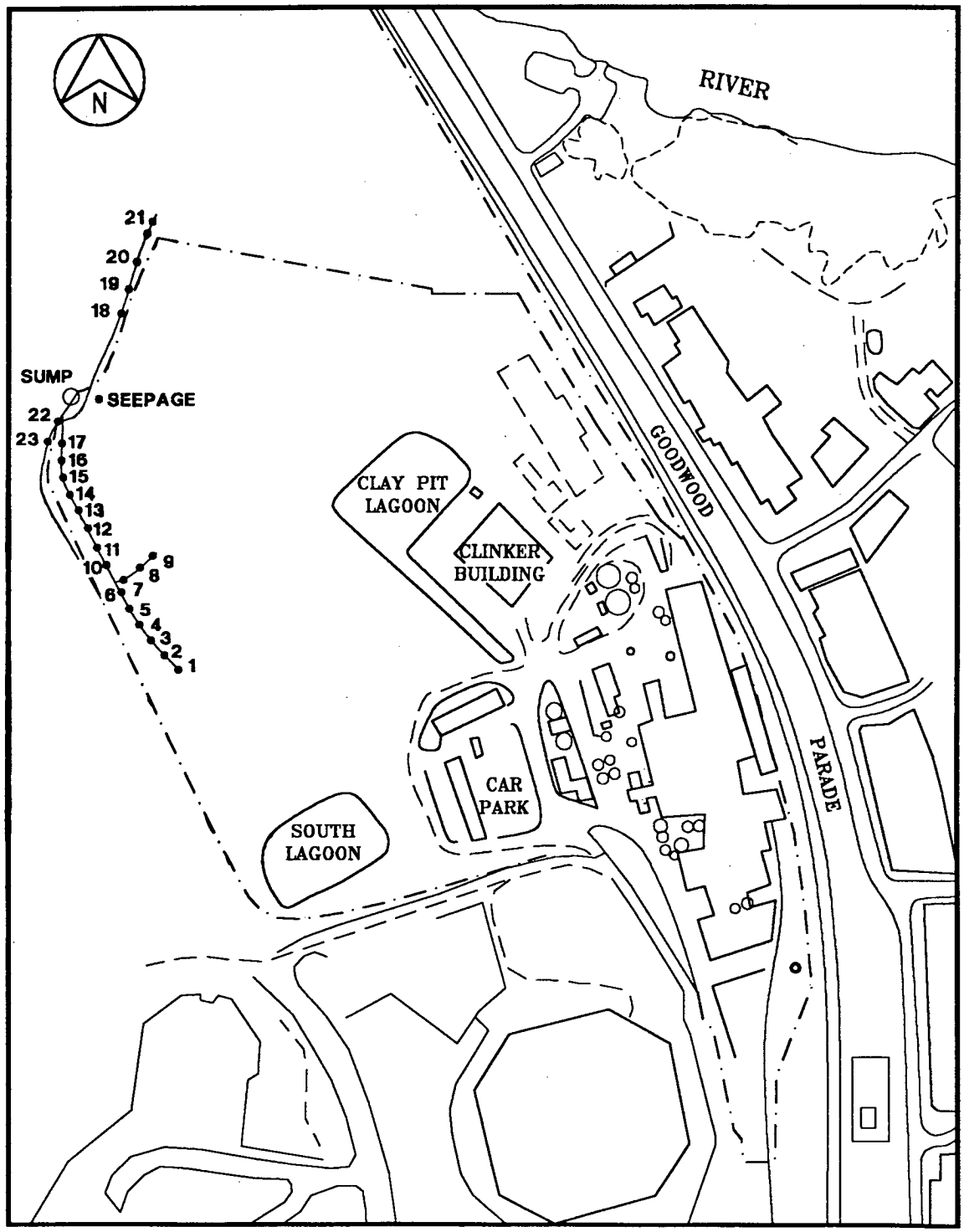
One of the first studies conducted solely on the drains occurred in 1990. A visual inspection identified groundwater leachate from the Swan Portland site was entering the drains. (AGC Woodward-Clyde, 1990). It was determined from this study that contamination of the drain could only be prevented by major remedial work which monitored groundwater and presented a detailed groundwater study which ensured all leachate leaving the site was intercepted and treated prior to disposal. (AGC Woodward-Clyde, 1990).

Further reports were produced in 1991 which addressed water quality management issues for the drains. (Dames and Moore, 1991a, Dames and Moore 1991b).

Surface water analyses of the Burswood Drain and SPWPD indicate that the SPWPD has high pH values upstream of the confluence. The Burswood drain can be considered neutral above the confluence, however, below this point input from the SPWPD results in an elevated pH (Ove Arup, 1993). The results are shown in Table 4 and sample points are illustrated in Figure A. The Swan River Trust requested Swan Portland to modify or upgrade the existing boundary leachate control system to mitigate against high pH waters impacting the Burswood Drain. The high levels of pH cause precipitated calcium and magnesium. When the high pH of the SPWPD drain mixes with the neutral Burswood Drain precipitation increases. To manage this problem, which often resulted in a milky plume entering the river, Ove Arup and Partners were commissioned to produce a leachate investigation and management plan (Ove Arup and Partners, 1994).

CMPS&F
ENVIRONMENTAL

FIGURE A
SWAN PORTLAND
LOCATION OF STREAM SAMPLING POINTS



LEGEND

- *SAMPLING POINTS*
- *DRAIN*

0 100m

SCALE

RDS No: N/A DATE OF LAST EDIT= 16/07/1996-16.03 CAD FILE: J:\PROJECTS\WE0767\FIG17

TABLE 4
pH Levels Within the Surface Waters Collected in SPWPD and Burswood Drain

Location Reference	20 November 1993	9 December 1993
	pH	pH
1	12.5	-
2	12.6	-
3	12.6	12.2
4	12.6	12.1
5	12.7	12.2
6	12.5	12.2
7	12.6	12.3
8	12.5	12.2
9	12.4	12.2
West Lagoon	12.3	12.2
10	12.6	12.1
11	12.5	12.1
12	12.6	12.0
13	12.6	11.9
14	12.6	12.0
15	12.5	11.9
16	12.4	11.9
17	12.4	11.9
Upper weir	12.1	11.8
Sump	9.6	NS
18	11.7	NS
19	11.8	NS
20	11.6	NS
Northern Perimeter Weir	11.7	11.2
21	8.7	NS
22	7.3	7.1
23	7.3	NS
Seepage	12.2	NS
Clay pit drain	12.1	NS

NS - Not sampled

This report concluded that the most conservative approach to the problem was to install an interception trench with a pumping system which would need to be sized to potentially facilitate the pumping of 200 m^3/day. Treatment of the pumped water would be effectively approached by mixing it (within a weir storage tank) with water from a water bore source rich in bicarbonate ions. Augmentation by dosing with additional acid may be required. The treated water could then be directly discharged to the Burswood Drain after settling out of the calcium carbonate has taken place. The sediment resulting from the calcium carbonate precipitation would require periodic removal and disposal (to Henderson tip).

The Ove Arup and Partners report (1994) also outlined an action plan to limit leachate migration to the Burswood Drain from the Swan Portland site. The action plan involved minimising surface water retention areas on the site. This has been done, and in addition discharge of highly alkaline wastewater from the works into the clay pit lagoon has stopped.

In order to determine the success of the management works the Surface Water Monitoring Plan was developed. This involved monitoring:

- the volume and quality of groundwater migrating towards the Burswood Drain through monitor bore sampling
- the quality of water within the Burswood Drain
- the flow volume of water within the Burswood Drain
- the quality of surface water west (upgradient) of the Burswood Drain and further east towards the Swan River outlet.

CONCLUSION

Past studies have discovered several contamination issues which are related to the groundwater. Although the occasional element, for example zinc, exceed criteria levels the primary problem with the groundwater is alkaline pH levels which can be corrosive and impact the on-site drains which intercept the groundwater. In fact, past studies of the SPWPD and Burswood Drain indicate their primary environmental water is the alkaline water which enters the drain and causes precipitation of calcium and magnesium.

Monitoring of the groundwater and the drains is ongoing as part of a contamination management and remediation strategy for the site.

APPENDIX D
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