

Remediation of Contaminated Land for Residential Purposes South Coogee

Western Australian Planning Commission

**Report and recommendations
of the Environmental Protection Authority**

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Summary and recommendations

The Western Australian Planning Commission proposes to remediate portions of 50.56 hectares (ha) of government land along the Owen Anchorage coastline in South Coogee. This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for the Environment on the environmental factors relevant to the proposal.

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

Relevant environmental factors

In the EPA's opinion, the following are the environmental factors relevant to the proposal, which require detailed evaluation in the report:

- (a) Soil contamination - extent of contamination and ability to remediate to intended use;
- (b) Groundwater quality - nature of contamination and impacts on marine environment; and
- (c) Marine water and sediment quality - risk of contamination by groundwater.

Conclusion

The EPA has considered the proposal by the Western Australian Planning Commission to remediate portions of the 50.56 ha of government land along Owen Anchorage coastline in South Coogee, approximately 5km south of Fremantle, and has concluded that there is currently insufficient information available to determine if the proposal is environmentally acceptable. However subject to further investigations and satisfactory implementation by the proponent of the recommended conditions set out in Appendix 5 which includes the proponent's commitments, the proposal is capable of meeting the EPA's objectives.

The EPA considers that the proposal to remove the source of contamination, such as soil and free floating hydrocarbon product from the water table, is the minimum required to reduce groundwater contamination.

The EPA notes that this proposal contains land which is within the overall Port Catherine Development rezoning proposal but considers that the recommendations for this proposal do not pre-empt any recommendations or conclusions that the EPA may form, as a result of the assessment of the Port Catherine Development proposal.

Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister notes that the project being assessed is for the remediation of portions of 50.56 ha of government land along the Owen Anchorage coastline in South Coogee.
2. That the Minister considers the report on the relevant environmental factors as set out in Section 3;
3. That the Minister notes that further investigations of soil, groundwater and sediment quality are to be undertaken to demonstrate the full extent and level of contamination at the site and to determine the environmental and health risk posed to public health and the environment, if the proposed methods of remediation are to be implemented;
4. That the Minister notes that it is the EPA's opinion that there is currently insufficient information available to determine if the proposal is environmentally acceptable. However subject to further investigations and satisfactory implementation by the proponent of the recommended conditions set out in Appendix 5 which includes the proponent's commitments, the proposal is capable of meeting the EPA's objectives.

5. That the Minister imposes the conditions and procedures recommended in Appendix 5 of this report.

Conditions

Having considered the proponent's commitments and information provided in this report, the EPA has developed a set of conditions which the EPA recommends be imposed if the proposal by the Western Australian Planning Commission to remediate portions of 50.56 ha of government land along the Owen Anchorage coastline in South Coogee, approximately 5km south of Fremantle, is approved for implementation. These conditions are presented in Appendix 5. Matters addressed in the conditions include the following:

- (a) the proponent shall fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 5; and
- (b) the proponent shall prepare an Environmental Management Programme which will include plans for:
 - soil investigation and sampling;
 - environmental and health risk assessment;
 - leachate tests on flyash;
 - soil testing for volatile organic carbons;
 - groundwater monitoring and contingency management;
 - groundwater fate and transport modelling;
 - dust and noise/vibration management; and
 - transport management.
 - soil remediation validation;
 - groundwater validation;
- (c) requirement for memorials on titles to ban groundwater use, if necessary.

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1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment on the environmental factors relevant to the proposal by the Western Australian Planning Commission (WAPC), the proponent, to remediate portions of 50.56 hectares (ha) of government land along the Owen Anchorage coastline in South Coogee, approximately 5km south of Fremantle (Figures 1 and 2).

A formal Project Agreement between the WAPC and Port Catherine Developments Pty Ltd (PCD), defines government and developer responsibilities in order to facilitate the development of Port Catherine. Under the terms of the Project Agreement, the WAPC is required to remediate and assemble the government land within the project area for acquisition by PCD. PCD is to obtain the necessary approvals to develop the land. This agreement was endorsed by the Western Australian Cabinet in May 1997.

In early 1996, the Environmental Protection Authority (EPA) set the level of assessment for the remediation of the government land at Consultative Environmental Review (CER) under Section 38 of the *Environmental Protection Act 1986*. The remediation is to be undertaken to enable rezoning of the land as part of a Metropolitan Region Scheme (MRS) Amendment No.1010/33 for Port Catherine. The MRS is being formally assessed by the EPA under Section 48(1) of the *Environmental Protection Act 1986*. The principal elements of the amendment include rezoning of former industrial land to Urban, rezoning an offshore waterway area to Urban, and rezoning of part of a Parks and Recreation reservation to Urban and Primary Regional Road reservation, to facilitate the Port Catherine Development proposal. The Amendment area is located at South Coogee in the City of Cockburn and lies immediately south of the old South Fremantle Power Station.

The State WAPC currently owns 50.56 ha of land within the Amendment area of the MRS and proposes to remediate government land for residential purposes. This does not include non-government or private land. Once the Government land is remediated to residential standards, it will be made available for sale to PCD and will be part of the PCD development. PCD will ultimately be responsible for the redevelopment of this land together with approximately 9.79 ha of non-government land. Remediation of the non-government land will be assessed by the EPA via the MRS Amendment.

A portion of the government land is contaminated by chemicals produced from past industrial activities including hide storage and processing, tanning, chemical manufacture, oil processing and flyash disposal. Soil and groundwater investigations have been undertaken by several consultants over the past five years to determine the nature and extent of contamination. Investigations have also been undertaken on the offshore sediments adjacent to the project area. Soil contamination within the project area is generally limited to approximately 6 ha of the total area and confined to the top 2 to 3 metres of the soil profile. However, a smaller area (0.6 ha) of contamination extends to an average depth of 10 metres. Included in the contaminated area are a number of undeveloped lots and reserves.

The EPA's decision to assess the proposal at the level of CER was based on three main factors, namely soil contamination, groundwater protection and protection of marine water and sediment quality.

Further details of the proposal are presented in Section 2 of this Report. Section 3 discusses environmental factors relevant to the proposal. The conditions and commitments to which the proposal should be subject, if the Minister determines that it may be implemented, are set out in Section 4. Section 5 provides Other Advice by the EPA; Section 6 presents the EPA's conclusions and Section 7, the EPA's recommendations.

Appendix 6 contains a summary of submissions and proponent's response to submissions and is included as a matter of information only and does not form part of the EPA's report and recommendations. Issues arising from this process and which have been taken into account by the EPA appear in the report itself.

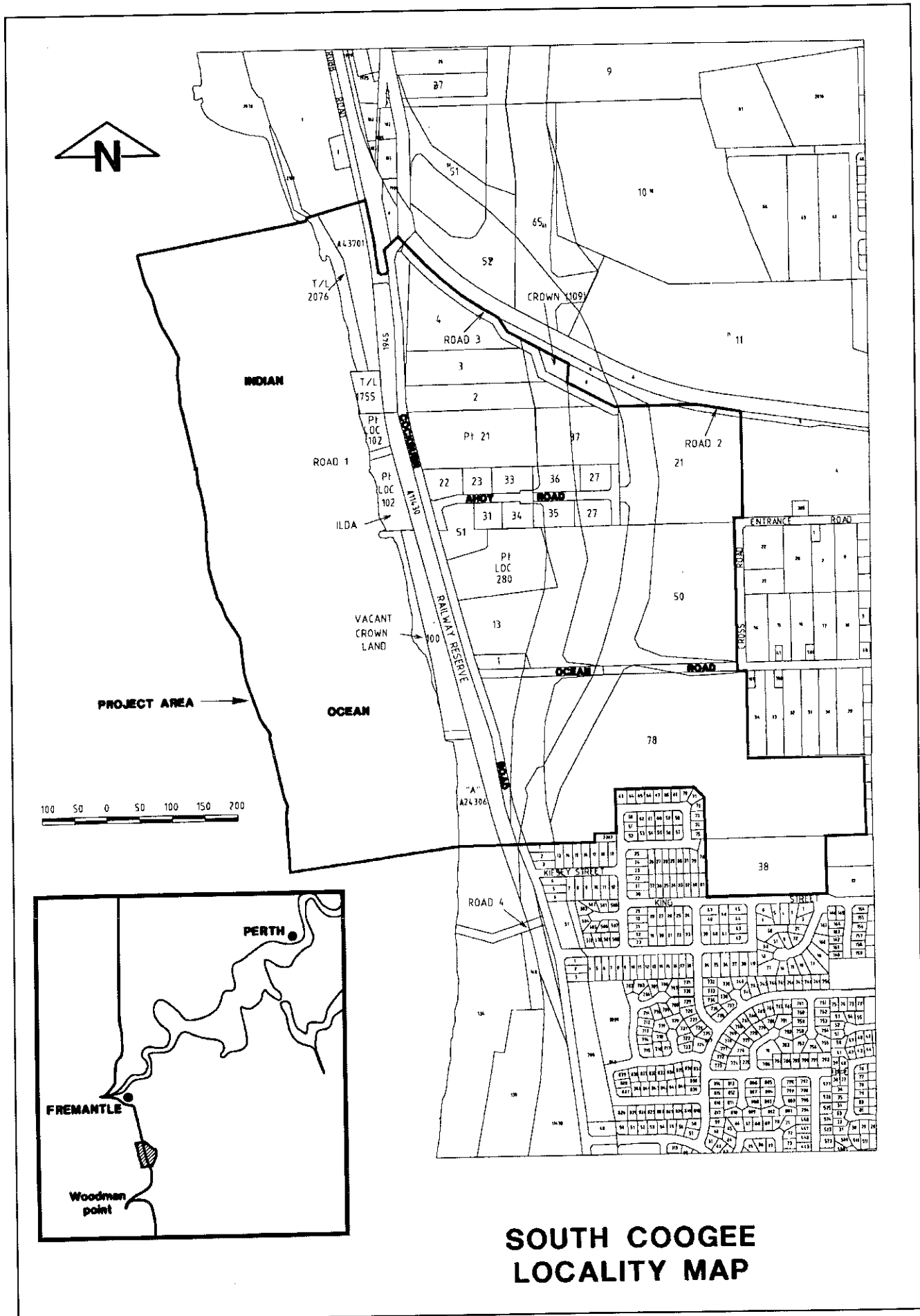


Figure 1. Location of WAPC residential development in South Coogee.

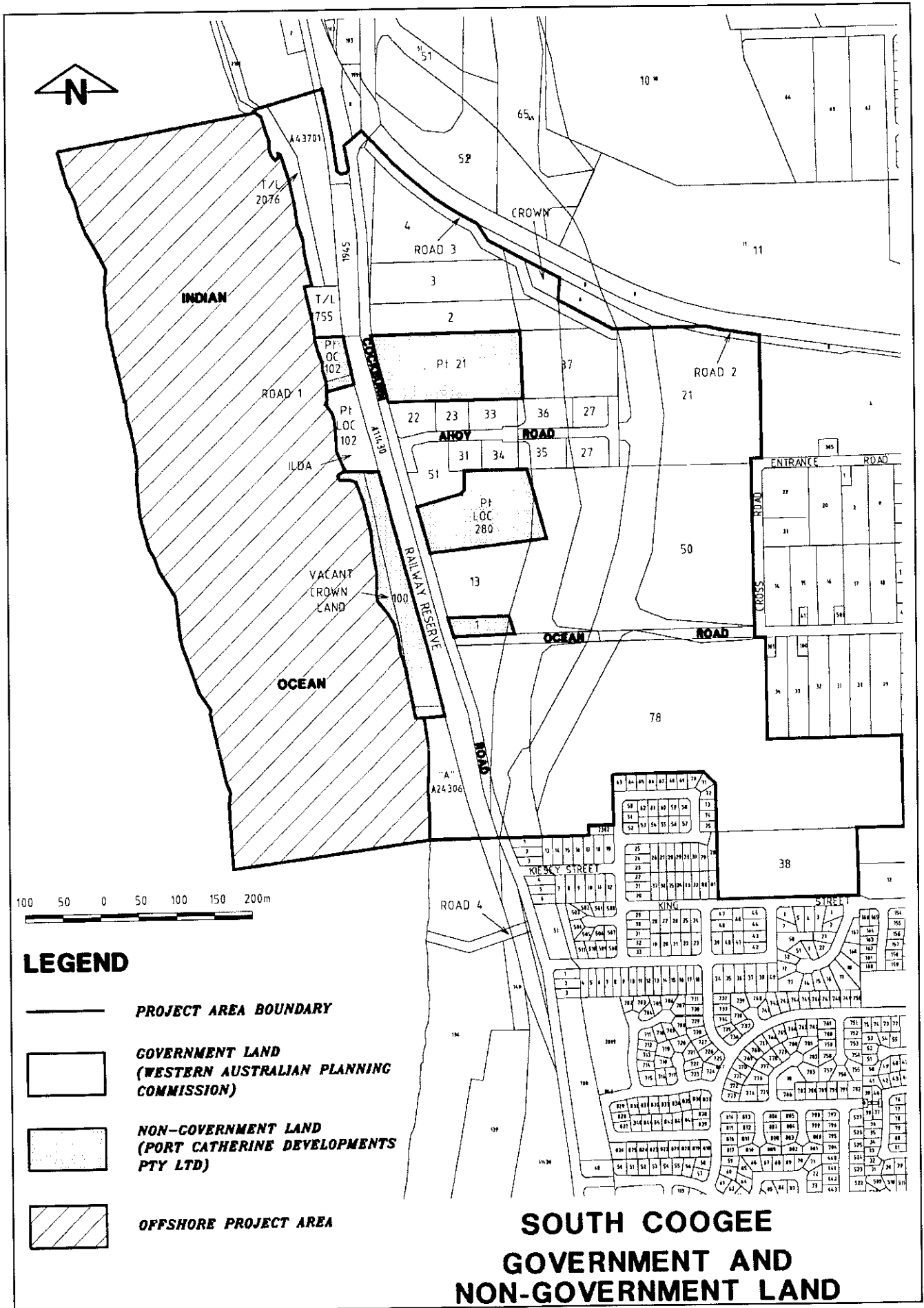


Figure 2. Government and non-government land.

2. The proposal

The Western Australian Planning Commission (WAPC) proposes to remediate portions of the 50.56 ha of government land along the Owen Anchorage coastline in South Cooee, approximately 5km south of Fremantle (Figures 1 and 2) (CMPS&F, 1998).

2.1 Soil contamination

There are 27 lots on the 50.56 ha land area. Soil contamination within the project area is generally limited to approximately 6 ha of the total area and confined to the top 2 to 3 metres of the soil profile (Figure 3). Five lots account for 90% of the total volume of contaminated soil. It has been estimated that approximately 52,000 cubic metres (m³) of soil is contaminated. The major source of soil contamination is heavy metals. Four particular lots have significant levels of petroleum hydrocarbons which extends approximately 10 metres down to the water table. In addition to the heavy metal and petroleum hydrocarbon contamination, approximately 38,000 m³ of flyash, which contain high levels of barium, has been disposed at three locations over a total area of 0.75 ha.

The soil contamination has the potential to pose a threat to human health through direct contact, and can also act as an on-going source for groundwater contamination.

The proposal is to remove, by excavation, 80% of the contamination which occurs in the top 2 to 3 metres of the soil to a landfill site. This includes the removal of contaminated soil where the contaminant levels exceed the ANZECC Investigation 'B' or Dutch 'B' (in the absence of ANZECC 'B') criteria for residential landuse.

It is proposed to remediate, if necessary, the remaining 20% of contaminated soil, which exists at depth. The proposed clean-up criteria for this material will be site specific, derived by undertaking an environmental and health risk assessment (HRA). The derived criteria will be subject to the requirements of the EPA on advice of the Health Department of Western Australia and the Department of Environmental Protection. The contaminated material will be remediated, if the HRA indicates a risk to public health or the environment.

It is proposed to undertake soil testing for volatile organic carbons at sites where petroleum hydrocarbons were detected, to ensure that remediation poses no significant health risk to workers and the public. It is also proposed to monitor air quality for volatile organic carbon, during excavation works, to ensure that remediation is carried out in a safe manner.

Where the lots are contaminated with flyash and it is proposed to contain the material on-site, leachate tests on flyash is to be undertaken to assess the risk of leachate contamination to groundwater and the marine environment. If leachate tests indicate that there is no significant risk to the environment and flyash is to be contained on-site, it is proposed to cover the flyash with 1 metre of clean sand fill to prevent public health risk. It is proposed to develop these lots as open parkland areas and not for residential purposes.

The proposal also includes a site validation test to ensure the land is suitable for residential landuse.

2.2 Groundwater contamination

Groundwater beneath a number of the sites is contaminated with heavy metals, particularly copper, mercury and zinc, and petroleum hydrocarbons which exist as a 'free phase product' at the water table. Investigations by consultants have detected significant groundwater contamination within a relatively small area along Ahoy Road (less than 1 ha). Contamination in the form of copper, nickel and petroleum hydrocarbons has been detected beneath four lots (Figure 4). Monitoring has also detected free floating hydrocarbon product on the water table at

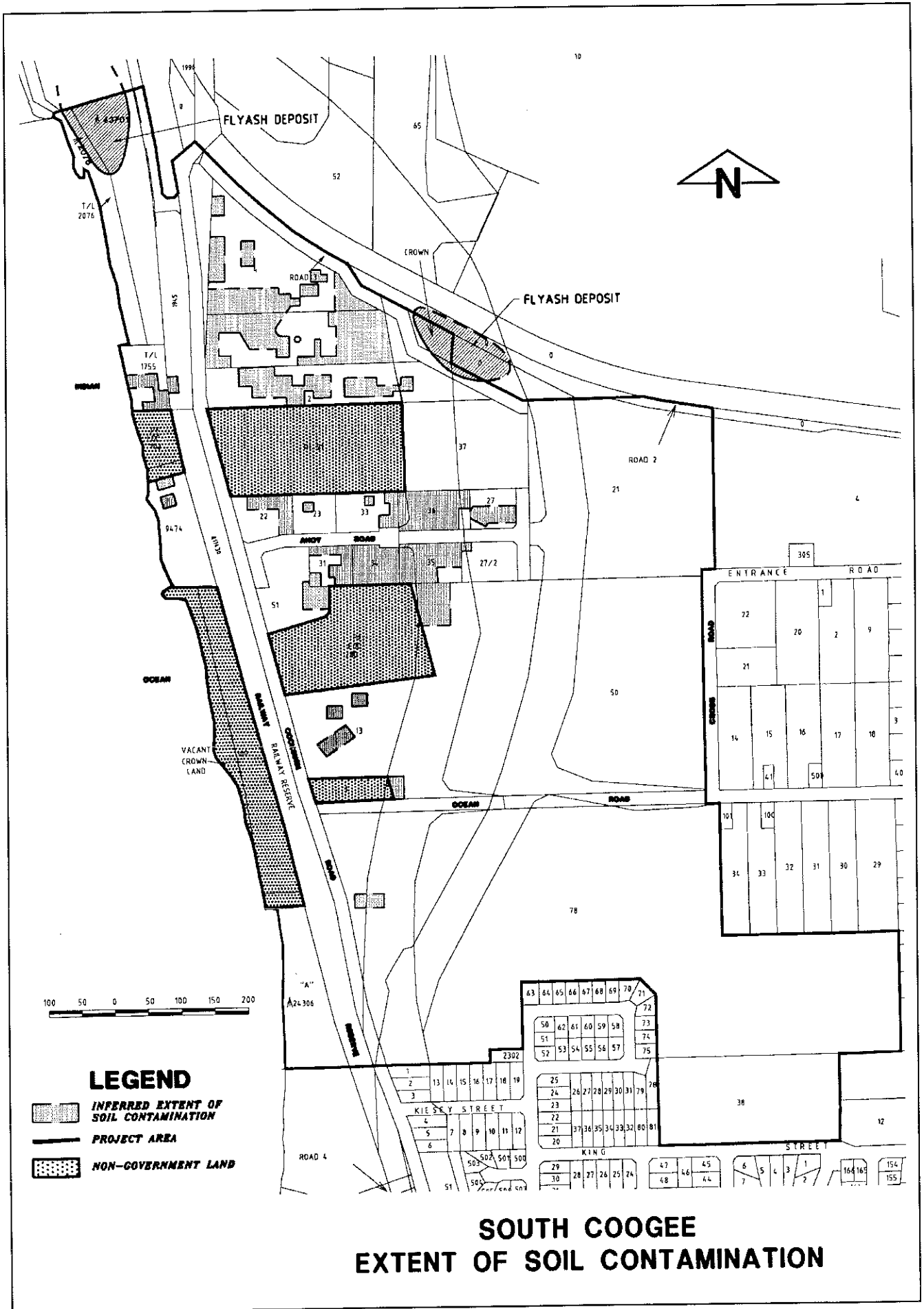


Figure 3. Extent of soil contamination.

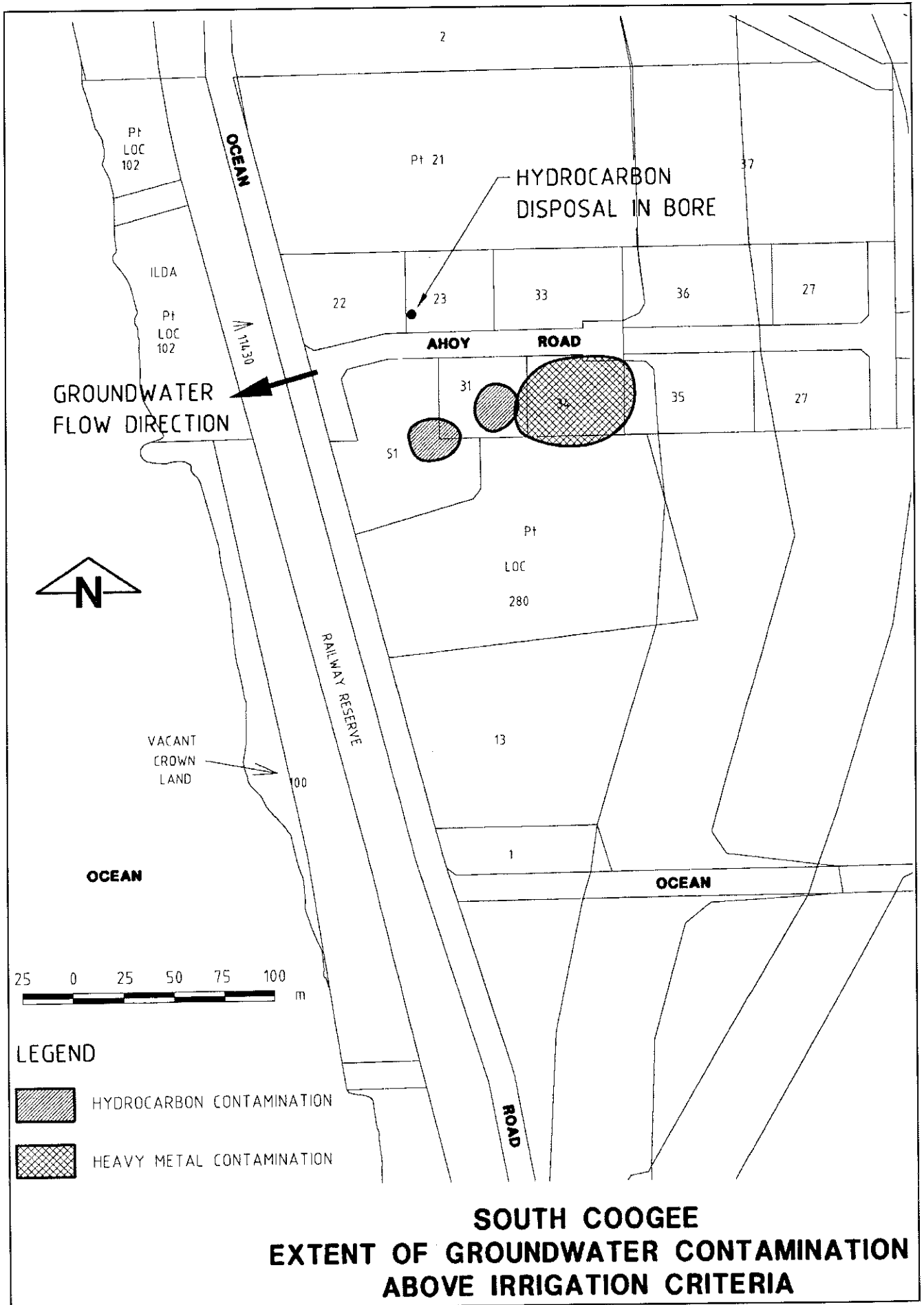


Figure 4. Location of groundwater contamination in South Coogee.

four locations (lots 23, 31, 34 and 51). At one site, the product has been found to extend no more than 10 metres downgradient of the spill. Dissolved phase hydrocarbons have also been detected some 40 metres downgradient of a second source (an old cavern) on the same site. In terms of proximity to the ocean, the closest source is some 175 metres upgradient. Elevated levels of nutrients (nitrates) have also been detected under several sites.

Contamination of the underlying groundwater has affected the use of groundwater for irrigation purposes and has the potential to degrade marine water quality and the nearby aquatic environment of Owen Anchorage in Cockburn Sound.

The proposal is to recover sources of contamination which impact or have the potential to impact on the underlying groundwater. Contamination sources including free phase petroleum hydrocarbons will be removed from the water table.

Potential groundwater impacts will be managed by monitoring groundwater quality at the plume sites and at locations downgradient of contamination sources. Fate and transport modelling will also be undertaken to predict plume movement and to assess the risk of residual hydrocarbons and metals to the marine environment. The model will include geochemical data to assess the capacity for the aquifer to retain the metals. In the event that groundwater monitoring and fate and transport modelling indicate that significant environmental impacts are likely to occur, a groundwater contingency plan for remedial action is to be prepared and implemented. The plan will describe measures to ameliorate such impacts, and consider practical management techniques and groundwater abstraction, treatment and containment options. Groundwater pumping tests are also to be undertaken to determine groundwater capture zones for domestic bores likely to be impacted by contamination plumes. The tests should demonstrate the potential off-site impacts to domestic bores, that are outside the project area, from the presence of contaminants in groundwater within the capture zone of the bores.

The proposal also includes banning the use of contaminated groundwater for domestic and irrigation supplies, by placing memorials on titles until the groundwater quality becomes acceptable.

2.3 Sediment contamination

Offshore sediments are generally free of contamination with the exception of low levels of arsenic located near the shoreline north of Ahoy Road up to the northern boundary of the project area (Figure 5). The low arsenic levels are marginally above the Effects Range Low (ERL) but do not exceed the Effects Range Medium (ERM) criteria above which remediation is required (DEP, 1996a).

The proposal is to reassess those areas identified in excess of the ERL in case the sediments drift from one location to another. Sediment quality is to be monitored at several sites within an estimated area of 7 ha of seabed, where sediment contamination exceeds the Effects Range Low (ERL). The ERL levels have been established by the Department of Environmental Protection to ensure that the draft Environmental Quality Objectives (EQO) 2, Class II criteria used to ensure the maintenance of aquatic ecosystems, are met.

The proponent, in consultation with the DEP, will assess the sediment quality data to determine whether the sediments pose any risk to the marine environment. If the sediments are likely to pose a risk, then a remedial action plan will be developed and implemented to minimise the risk.

A summary of the key characteristics of the proposal is presented in Table 1. A detailed description of the proposal is provided in Section 5 of the CER (CMPS &F, 1998).

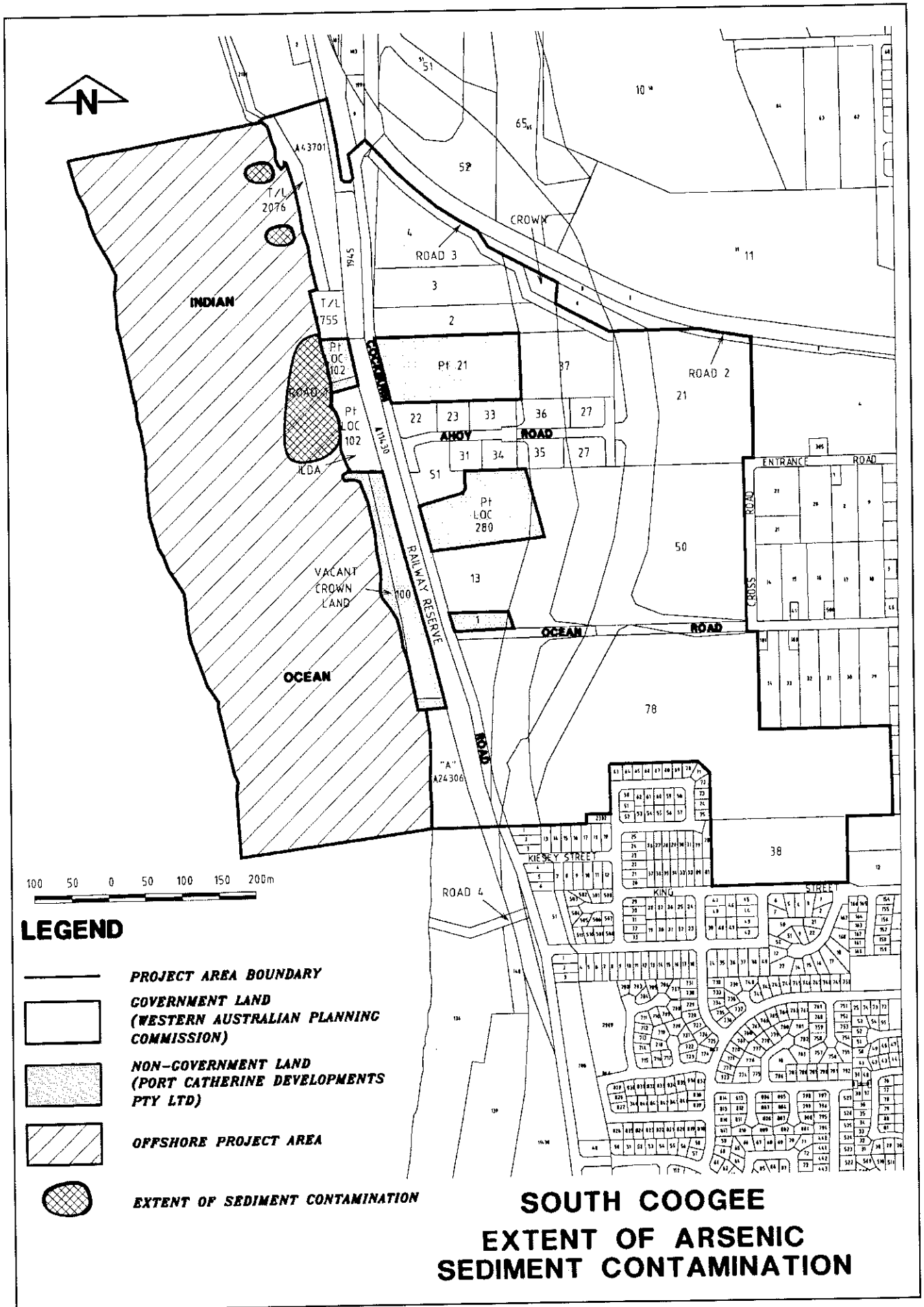


Figure 5. Extent of arsenic sediment contamination.

Table 1 - Summary of key proposal characteristics

Element	Description
SITE IDENTIFICATION	<p>The development site is government owned land in the Port Catherine Project area with an area of 50.56 ha along the Owen Anchorage coastline in South Coogee, approximately 5 km south of Fremantle.</p> <p>The project area includes : lots 2, 3, 4, 13, 51, 78, 1755, 9474 (Cockburn Road); lots 21, 22, 23, 27, 27/2, 31, 33, 34, 35, 36, 37 (Ahoy Road); lot 38 (King Street); lot 50 (Ocean Road); Reserves 24306,43701, 11430 and 1945, Town Lot(T/L) 2076; lot 109.</p>
CURRENT ZONING	Industrial
PROPOSED ZONING	Residential
DEMOLITION	Old buildings to be demolished and removed
NATURE OF CONTAMINANTS	<p>Soil: Heavy metals (arsenic, chromium, copper and zinc), petroleum hydrocarbons and flyash (barium).</p> <p>Groundwater: Heavy metals (copper, nickel), petroleum hydrocarbons and nitrate.</p> <p>Sediment: Heavy metal (arsenic).</p>
REMEDATION and MANAGEMENT	
Soil	<ul style="list-style-type: none"> • remove approximately 52 000 m³ (80%) of contaminated soil which exceeds ANZECC 'B' or Dutch 'B' criteria and dispose to approved landfill; • remediate remaining 20% of contaminated soil at depth to site-specific criteria based on environmental and health risk assessment to the requirements of the EPA; • undertake leachate tests on flyash to assess the risk of contamination to groundwater, if flyash is to be contained on-site; • test contaminated soil for the likely generation of volatile organic carbons particularly at sites (lot 31, 34, 1755 and 9474) where petroleum hydrocarbons were detected; • monitor the volatile organic carbons levels during remediation at sites likely to pose a significant risk; • cover approximately 38 000 m³ (0.75 ha) of flyash with at least 1metre of clean fill, if leachate tests on flyash indicate no significant risk to the environment; • reuse soil with contamination levels less than ANZECC 'B' for backfill.
Groundwater	<ul style="list-style-type: none"> • remove completely free phase petroleum hydrocarbons contamination source from the water table; • conduct long-term monitoring of groundwater at plume sites and downgradient of plume; • conduct fate and transport modelling of particular contaminants in groundwater to determine risk posed to the marine environment; • undertake pumping tests to determine off-site impacts to domestic bore water quality by determining groundwater capture zones; • prepare and implement groundwater contingency plan, if groundwater monitoring, fate and transport modelling indicates a risk to the environment; • validate model with further groundwater monitoring; • ban the use of contaminated groundwater by placing memorials on titles;

Marine sediments	<ul style="list-style-type: none"> • monitor sediments and predict impact based on data; • identify arsenic form in sediments in excess of the Effects Range Low (ERL) criteria recommended for the maintenance of the ecosystem; • implement remedial contingency plan, if necessary.
Dust	<ul style="list-style-type: none"> • prepare and implement a dust management plan for both site works and transportation of contaminated material off-site.
Noise and vibration	<ul style="list-style-type: none"> • prepare and implement a noise management plan outlining noise mitigation measures and monitoring procedures.
Public safety and environmental health	<ul style="list-style-type: none"> • prepare and implement a public safety and environmental health plan.
Worker safety and occupational health	<ul style="list-style-type: none"> • prepare and implement an occupational health and safety plan.
Transport management	<ul style="list-style-type: none"> • prepare and implement a transport management plan.

The potential impacts of the proposal initially predicted by the proponent in the CER document (CMPS&F, 1998) and their proposed management are summarised in Table 2 (CER, Appendix 1).

Details on the historical use and identified contaminants of each site within the project area are also provided in Table 2.

3. Relevant environmental factors

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

The identification process for the relevant factors is summarised in Appendix 3.

It is the EPA's opinion that the following are the environmental factors relevant to the proposal, which require detailed evaluation in this report:

- (a) Soil contamination - extent of contamination and ability to remediate to intended use;
- (b) Groundwater quality - nature of contamination and impacts on marine environment; and
- (c) Marine water and sediment quality - risk of contamination by groundwater.

The above relevant factors were identified from the EPA's consideration and review of all environmental factors (preliminary factors) generated from the CER document and the submissions received, in conjunction with the proposal characteristics.

Details on the relevant environmental factors and their assessment is contained in Sections 3.1 - 3.3. The description of each factor shows why it is relevant to the proposal and how it will be affected by the proposal. The assessment of each factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

A summary of the assessment of the environmental factors is presented in Appendix 4.

Table 2 - Lots within government land proposed for remediation showing historical landuse and potential contaminants.

Lot/Reserve Locations	Historical uses	Contaminants
3, 4, 13, & 51	Hide processing	Heavy metals
23	Hide storage	Heavy metals
2	Fellmongering	Heavy metals
2, 31 & 1755	Tanning	Heavy metals, hydrocarbons (31 only)
9474	Tallow processing	Heavy metals , hydrocarbons
51	Crayfish processing	Heavy metals
22	Edible oil production	Heavy metals
34	Chemical manufacture	Heavy metals, hydrocarbons
33	Fuel distribution Drum storage	Heavy metals, hydrocarbons
T/L (Town lot) 2076, 43701 & 109	Flyash disposal	Heavy metals, flyash (barium)
11430 & 1945	Railway reserve	Hydrocarbons
24306	Reserve	none
78	Stormwater sump	Heavy metals
35	Dumping	Heavy metals
21, 27, 27/2, 36, 37, 38 & 50	Undeveloped sites	Heavy metals

3.1 Soil contamination

Description

A portion of the 50.56 ha of land along the Owen Anchorage coastline in South Coogee is contaminated by chemical compounds produced from past industrial activities. These activities included hide storage and processing, tanning, chemical manufacture and flyash disposal.

There are approximately 27 sites within the project area. Five of the sites account for 90% of the total volume of 52,000 m³ of contaminated soil. These sites include lots 2 (fellmongering), 3&4 (hide processing and drying), 31(tannery), 34 (chemical manufacture) and 35 (undeveloped, illegal dumping). Soil contamination is limited to approximately 6 ha of the total project land area and confined to the surface soils. Included in the contaminated area are a number of undeveloped lots and reserves.

Over the past several years, numerous investigations have been undertaken by environmental consultants to identify the nature and extent of soil contamination at the project site. Details of these investigations are presented in the CER (CMPS&F, 1998) and other investigation reports (CMPS&F, 1998). Consultants Sinclair Knight Merz (SKM) performed a preliminary assessment on several sites (SKM, 1993, 1994a, 1994b, 1994c, 1995, 1997a, 1997b, 1997c, 1998). The assessments were designed to provide an indication of the potential of a site activity, either past or present, to cause soil and groundwater contamination. Site investigations included lots 2, 3, 4, 31, 34 and 35, which were considered to be significant sources of contamination within the project area.

Following the preliminary assessments, more detailed assessments were performed on all government land considered to exhibit a potential for contamination. SKM undertook further post-demolition assessment work in 1996 and 1997 on a number of locations which showed soil contamination.

Although extensive soil sampling was undertaken on the surface and at depth by consultants, reports indicate that there was incomplete soil sampling carried out at depth on several sites including lots 22, 33, 35, 36 and 37 Ahoy Road, 50 Ocean Road, 51 Cockburn Road and Reserves 43701 and T/L2076. A review of the investigation data also indicates that soil sampling was not undertaken beneath existing or demolished building structures located on some sites as these locations were not accessible. Further soil sampling under these buildings structures is to be carried out on several sites including lots 13, 51 and 1755 Cockburn Road and lots 22, 23 and 31 Ahoy Road, following demolition and prior to development of the site.

The other sites are considered to be of low contamination potential based on previous land uses. However, prior to redevelopment, the proponent has committed to carrying out site validation testing to confirm that these sites are suitable for residential land use and to undertaking remedial action where contamination is found.

The major source of soil contamination is heavy metals (arsenic, chromium, copper and zinc). The metal contamination at the site is generally present in the top 2 to 3 metres in areas such as ponds and lagoons where the chemicals were disposed or where airborne contaminants may have deposited. Four particular sites (lots 31, 34, 1755 and 9474) have significant levels of petroleum hydrocarbons which extends approximately 10 metres down to the water table. The hydrocarbons exists in a semi-volatile heavy fraction chemical form and is not considered likely to produce volatile organic carbons (VOCs) during remediation works.

Contaminated soil, however, has the potential to affect human health through direct contact, and is also an ongoing source for groundwater contamination. To ensure that the VOCs do not pose a health risk to workers and the public during remediation works, soil tests is to be undertaken prior to remediation to assess the potential for VOCs to be generated during excavation works. It is also proposed to monitor for VOC levels in the atmosphere, during remediation, to ensure that workers operate in a safe manner. VOC monitoring is to be undertaken at sites where petroleum hydrocarbons have been detected previously.

Details of heavy metal and hydrocarbon contamination at the sites are given below (CMPS&F, 1998).

Contaminants

Chromium

Chromium levels detected at lots 2, 3, 4, 13, 23, 31, 33, 34 and 1755 exceeded the ANZECC 'B' criterion (50mg/kg) for residential landuse. The most contaminated sites included the sites previously used as a tannery (lot 2, 31,1755), for hide processing and drying (lots 3 and 4), hide storage (lot 23) and chemical manufacturing (lot 34).

With the exception of lots 31 and 34, where contamination extended to a depth of 10m, contamination of other lots was generally confined to the top 2 to 3 metres of the soil.

Arsenic

Arsenic levels detected at lots 2, 3, 4, 13, 34, 35, 51 and 1755 exceeded ANZECC 'B' criterion (20mg/kg) for residential landuse. The most contaminated sites were lots 2, 3, 4 and 35 (undeveloped site used for dumping).

With the exception of lot 34, contamination of other lots was generally confined to the top 2 to 3 metres of the soil.

Copper

Copper levels detected at lots 2, 3, 4, 22, 27, 27/2, 31, 33, 34, 35, 36, 50, 51 and Reserve 43701 and T/L2076 exceeded the ANZECC 'B' criterion (60mg/kg) for residential landuse. The most contaminated sites included lots 31, 33, 34 (copper sulphate manufacture) and 35.

With the exception of lot 31 and 34, where contamination extended 10 metres down to the water table, contamination of other lots were generally confined to the top 2m of the soil.

Lead

Lead levels detected at lots 2, 22, 31, 33, 34, 35 and 78 exceeded the ANZECC 'B' criterion (300mg/kg) for residential landuse. The most contaminated sites included lots 33, 34, 35.

Zinc

Zinc levels detected at lots 2, 3 and 4, 13, 22, 31, 33, 34, 35, 1755, 9474 and Reserve 43701 and T/L2076 exceeded the ANZECC 'B' criterion (200mg/kg) for residential landuse. The most contaminated sites included lots 31, 33, 35 and 1755.

Mercury

Mercury levels detected at lots 34 and 35 exceeded the ANZECC 'B' criterion (1mg/kg) for residential landuse. All other sites tested had levels less than 1mg/kg.

Flyash

Flyash deposits were detected at lots 109 and Reserve 43701 and T/L 2076. Soil analysis at these sites indicated that the flyash deposits were present in surface samples and at depth. The levels of copper, nickel and zinc were marginally above the ANZECC 'B' criteria for these heavy metals.

The barium levels at lot 109 (4,500mg/kg) and reserves 43701 & T/L 2076 (7,600mg/kg) exceed the Dutch 'B' criterion (400mg/kg). These sites are not proposed for residential development.

Approximately 38,000 m³ of flyash has been disposed at these sites over an area of 0.75ha.

Hydrocarbons

Elevated concentrations of hydrocarbons (as total petroleum hydrocarbons) were detected at lots 31, 34, 1755 and 9474. These levels exceed the Dutch 'B' criterion (1000 mg/kg for greater than Carbon 10) for residential landuse.

Phenols and chlorophenols

Phenol (1500mg/kg) and chlorophenol (123mg/kg) levels detected at lot 1755 Cockburn Road exceeded the Dutch 'B' criterion for phenol (1mg/kg) and chlorophenol (1mg/kg). The site was previously used as a tannery.

Pesticides (organochlorine and organophosphate)

The organochlorine levels detected at lots 21, 22, 23, 31, 33, 38, 50, 9474, 11430 and 1945 were less than the Dutch 'B' criterion (1mg/kg). Similarly, the organophosphate (as chlorpyrifos) levels detected at lots 23, 31, 9474, 11430 and 1945 were less than 0.1mg/kg.

Proposed remediation options

To manage the impact of soil contamination on groundwater and the environment, the proponent has investigated a number of remediation options including:

- (a) on-site and off-site treatment;
- (b) disposal to landfill; and
- (c) on-site containment

Treatment options

The proponent has considered treatment options such as chemical stabilisation, soil washing, soil fractionation, bioremediation and on-site containment. The main contaminants at the site include heavy metals (including barium present in flyash) and petroleum hydrocarbons.

Chemical stabilisation techniques can be applied to the soil to reduce the availability of the contaminant to the environment. Chemical fixation, micro and macro encapsulation are all approaches to chemical stabilisation. Remediation by chemical stabilisation techniques in particular can be expensive and are generally not considered suitable for organic contamination such as petroleum hydrocarbons.

Soil washing involves the use of solvents such as water, surfactants and acids to flush through the contaminated material, either in-situ or ex-situ, to remove the contamination from the soil. Ex-situ processes can be very effective in removing heavy metals from permeable soils such as sand. The process does create a wastewater stream which requires treatment and disposal. Soil washing can be expensive and is not considered for treating the contaminated soil.

Soil fractionation uses mineral processing technology to remove contaminants that are bound to the soil particles. Separation of particles is based on differences in physical properties such as grain size and specific gravity. The limitation with this process is that the contaminant must be associated with a particular soil characteristic for separation to be possible. This technology can be expensive and has not readily been used in Australia.

Bioremediation relies on the ability of microbial organisms to break down contaminants into harmless byproducts. This can be achieved either in or ex-situ, however the latter is generally considered more effective. Bioremediation is ideally suited to organic compounds. The presence of heavy metals can adversely affect the process of bioremediation. For the technique to be effective, the contaminated material needs to be in contact with the microorganism for a period of time, especially if the organic contaminants are initially resistant to break-down.

All the above treatment techniques were considered by the proponent to be not practical based on the nature of the contaminants and the estimated volume of contaminated soil to be remediated. The proponent proposes to remediate the site by using a combination of off-site disposal to a landfill site and on-site containment methods. Landfill disposal of contaminated soil is the most common approach to remediation in Western Australia. This approach is cost effective compared to the above on-site treatment techniques discussed, and the removal of contaminated soil ensures that the site is cleaned up to the required standard for the intended landuse. Disposing of contaminated soil places pressure on the capacity of the landfill facility. However, some contaminants such as heavy metals are better suited to landfill disposal, as they cannot be treated easily.

The preferred option is to remediate the site by:

- removing 52,000 m³ (80%) of contaminated soil from the top 2 to 3 metres of the soil which exceeds ANZECC 'B' or Dutch 'B' criteria to a landfill site;
- remediate, if necessary, the remaining 20% of contaminated soil, at depth greater than 2 metres, to site-specific derived criteria based on an environmental and health risk assessment (HRA);

- contain approximately 38,000 m³ of flyash on-site by covering with at least 1 metre of clean fill, if leachate tests indicate that the flyash poses no significant risk to the environment;
- reuse soil with contaminant levels less than ANZECC 'B' for backfill.

On completion of the site remediation, the proponent will carry out site validation tests to demonstrate that the site has been remediated to the appropriate level for residential landuse.

Submissions

Concerns were raised by government agencies regarding the uncertainty in the estimates of the quantity of material to be remediated. Concerns were also raised about the contamination beneath the existing buildings on some sites and the lack of investigation data to assess the extent of this contamination. The Department of Environmental Protection and the Water and Rivers Commission raised concerns about the lack of testing of soils for pesticides. Comments were also received from government agencies that the ANZECC 'B' levels should be used as first criteria for clean-up for residential landuse.

Submissions from government agencies also indicated that health risk assessment modelling should be undertaken for those sites where the removal of contaminated soil is not proposed so that the contaminant risk to public health may be assessed.

Concern was raised in public submissions on the proposed remediation strategy in relation to some sites and the clean-up criteria to be adopted. It was considered that there were insufficient data provided on the flyash areas and that flyash should be removed from the sites.

Assessment

The area considered for assessment of this factor is the 50.56 ha of government land along the Owen Anchorage coastline in South Coogee, approximately 5km south of Fremantle.

The EPA's environmental objective for this factor is:

- to ensure that the rehabilitation of the site is to an acceptable standard compatible with the intended land use and consistent with appropriate criteria.

According to EPA Guidance Statement No. 17, the preferred hierarchy approach for site remediation is for contaminated material to:

- be treated on-site and the contaminants reduced to acceptable levels; or
- be treated off-site and returned for reuse after the contaminants have been reduced to acceptable levels.

Disposal to an approved landfill and 'cap and contain' isolation measures should only be used if the preferred approaches are not practicable and if undertaken in an environmentally acceptable manner.

Waste characterisation

The EPA considers, on advice of the Department of Environmental Protection and the Water and Rivers Commission, that the full extent and nature of contamination at a number of sites has not been fully determined.

The EPA believes that the proponent would need to carry out further investigations to determine the extent of contamination under building structures; these include lots 51 Cockburn Road and 22 Ahoy Road. Additional soil sampling at depth should be carried out on several sites including lots 22, 33, 35, 50, 51, 43701 and T/L2076 to determine the vertical distribution of contaminants. All soil samples from these lots should be tested for heavy metals and pesticides. The EPA believes that validation testing should be performed on lots 36, 37, 38 Ahoy Road, reserves 1945, 11430, 24306, 43701 and 2076 to confirm the absence of contamination.

On-site and off-site treatment

The EPA recognises that on-site treatment of the contaminated soil may not be practical due to the quantity and nature of the wastes involved.

Disposal to landfill

The EPA believes that removal of the top 2 to 3 metres of soil to an appropriate landfill site will significantly reduce the source of contamination.

On-site containment

Where flyash is to be retained on lot 109, Reserve 43701 and T/L 2076, the EPA believes that leachate tests on flyash should be undertaken to demonstrate that the leachate does not pose a risk to groundwater. However, if the leachate tests indicate that there is no significant risk to groundwater, the EPA believes, on advice of the Health Department of Western Australia, that a minimum cover of at least 1 metre clean fill should be applied to minimise risk to public health, if flyash is to be contained on-site. The flyash covered areas should not be developed for residential purposes or for uses involving excavation such as infrastructure corridors for buried services.

If residential development is to occur on these lots, then it required to remediate the site to residential standards and subject to recommended Environmental Condition 6 (Appendix 5).

Where contaminants are present at depth, the EPA believes that an environmental and health risk assessment is to be undertaken to demonstrate that the contaminants do not pose a significant risk to public health and the environment. In addition, presence of contamination is to be recorded on the land title. The Department of Environmental Protection advised that contaminated land should be remediated according to the following hierarchy of clean-up criteria:

- ANZECC 'B' investigation level;
- Dutch 'B' criteria, where parameters are not listed in ANZECC 'B'; and

Site-specific criteria derived from an environmental and health risk assessment may be acceptable as target levels for clean-up subject to approval from the EPA on advice of the Health Department of Western Australia and the Department of Environmental Protection.

The EPA considers that unless an environmental and health risk assessment is carried out to the satisfaction of the EPA, validation of individual sites to ANZECC 'B' and Dutch 'B' criteria will be required to ensure that the site is suitable for residential landuse.

The EPA also considers there is insufficient information to determine that the proposal to remediate the site can be managed. The proponent should undertake further investigation and prepare an Environmental Management Programme which would address the following issues (recommended Environmental Condition 4, Appendix 5):

- soil sampling and testing;
- leachate testing of flyash for environmental risk assessment;
- environmental and health risk assessment;
- site drainage management;
- groundwater monitoring and contingency remedial action;
- groundwater fate and transport modelling;
- dust and noise/vibration management; and
- transport management;
- soil validation;
- groundwater validation;

In response to public submission, the proponent has made commitments to undertake further soil investigations (Commitment 5) to assess the nature and extent of contamination on sites where access has not been possible, to prepare and implement a validation programme (Commitment 20) to ensure that the remediated site is suitable for residential purposes, to manage the flyash contaminated sites to the approval of the Department of Environmental Protection (Commitment 21), and to remediate the project area in accordance with the clean-up criteria approved by the EPA (Commitment 1).

The proponent has also made commitments to undertake an environmental and health risk assessment (Commitment 2), to prepare and implement a transport management plan (Commitment 7) and a noise management plan (Commitment 13 and 14).

In addition, the proponent has made further commitments to consult and communicate with the community (Commitment 18) prior to and during remedial works.

Summary

Having particular regard to:

- (a) the proposed site remediation;
- (b) the proponent's commitments to undertake further site investigations, undertake leachate tests on flyash, assess the potential for soil to generate volatile organic carbons, monitor air quality for volatile organic carbons, place memorials on titles, where there is residual contamination, and ban the abstraction of contaminated groundwater, prepare and implement a validation programme, manage flyash, undertake environmental and health risk assessment and prepare transport and noise management plans; and
- (c) the advice of the Water and Rivers Commission, Department of Environmental Protection and Health Department of Western Australia;

it is the EPA's opinion that there is insufficient information available to determine if the proposal is acceptable. However, subject to further investigations and undertaking of remedial action, if required, to meet the acceptable standard compatible with the intended land use and consistent with appropriate criteria, the project is capable of meeting the EPA's objective.

3.2 Groundwater quality

Description

Investigations by environmental consultants have shown that significant groundwater contamination has occurred within a relatively small area along Ahoy Road. Groundwater beneath a number of areas is significantly contaminated at levels which preclude its use for irrigation and poses a risk to the marine environment, if not managed.

Groundwater underlying the site originates from the Jandakot Mound and flows in a west to north-westerly direction towards the ocean with an average gradient of 0.62 metres per kilometre (GTA, 1994). Groundwater contamination within the project area occurs predominantly in the superficial aquifer in the Tamala Limestone Foundation which overlies the Osborne Formation. Contamination of the underlying groundwater has the potential to degrade the water quality in the internal marina waterbody and nearby aquatic environment of Owen Anchorage in Cockburn Sound.

Groundwater fluctuates an average 0.43 metres a year from rainwater recharge (Davidson, 1995) and the water table near the coast is controlled by the ocean level and the prevailing climatic conditions over the recharge area to the east. Groundwater from the project site discharges over a saltwater interface. Contaminated groundwater also poses a risk to public health through direct contact, if used for irrigation purposes.

Groundwater in the South Coogee area was initially investigated in 1994 (GTA, 1994) as part of a regional hydrogeological study. The study considered a wide range of contaminants including nutrients in the top 4m of the underlying unconfined aquifer. A total of 13

groundwater monitoring bores were installed in strategic locations with a high potential for contamination. Groundwater flow direction is towards the ocean in a generally westerly direction. Depth to groundwater is a function of site topography ranging from a few metres near the coast to greater than 20m on the ridge.

Intensive groundwater investigations were also undertaken at sites considered to pose significant risk to the environment; these sites included lots 31 and 34, and the adjoining lot 51. Groundwater investigations were undertaken by consultants between 1995 and 1998 (SKM, 1995, 1997a, 1997b, 1997c; CMPS&F, 1998; BBG, 1998). Investigations have also shown that groundwater beneath several sites including lots 23, 31, 34, 2076 and 51 has been contaminated with heavy metals and hydrocarbons (CMPS&F, 1998). An abandoned bore at one site (lot 23) has been used for the disposal of vegetable oil; however, the oil has not spread outside the immediate vicinity of the bore.

Monitoring has detected free floating hydrocarbon product on the water table at four locations (lots 23, 31, 34 and 51) (Figure 3). At one site (lot 31) the product has been found to have moved up to 10 m downgradient of the spill. Dissolved phase hydrocarbons have also been detected some 40 m downgradient of a second source, an old cavern, on lot 31 which was used for waste disposal. This source of contamination is about 175m upgradient of the ocean. The plumes have not been fully delineated and therefore the extent of contamination downgradient is to be determined by further investigation and fate and transport modelling.

Copper and nickel contamination is associated with lot 34 Ahoy Road and is extensive beneath the 0.4 ha site. Contamination has been found to extend 20 m downgradient of the site, a distance of approximately 250 m upgradient of the ocean. The magnitude of contamination in the groundwater below this site is relatively low considering the residual soil contaminant levels. The maximum copper concentration observed at this site was 1 mg/L which is about 5 times the water quality criterion of 0.2mg/L set for irrigation purposes (ANZECC, 1992).

Elevated concentrations of nutrients (nitrate) in groundwater have been detected under several sites (lots 2, 3, 4, 13, 23, 31, 33, 51, 109, 1755, 9474, Reserves 43701, T/L2076, 11430 and 1945). Nitrate levels in groundwater bores have ranged from 0.5mg/L to 2.9mg/L. There are no irrigation water quality criteria for nitrates, however a nitrate level of 10mg/L is set for raw water quality (ANZECC, 1992). Raw groundwater is generally used for irrigation purposes in Western Australia. It should be noted that market gardens and other urban land uses east of the South Coogee area are considered to contribute to the high levels of nitrogen in groundwater.

Details of the sites where groundwater monitoring was performed is given in the CER (CMPS&F, 1998).

The proposed approach to managing and/or remediating contaminated groundwater will be:

- to remove the sources of contamination such as contaminated soil, free floating vegetable oil and petroleum hydrocarbon product which are affecting underlying groundwater;
- to undertake leachate tests on flyash, if left on site, to assess the risk to groundwater;
- to monitor groundwater quality entering the marine environment;
- to undertake fate and transport modelling to predict the migration of heavy metal and hydrocarbon contaminants present in the identified groundwater plumes. The model will include geochemical modelling to assess the capacity of the aquifer to adsorb the metals;
- to prepare a contingency plan which considers all practical management techniques including groundwater extraction, treatment and containment options, if fate and transport modelling indicates that there is insufficient natural attenuation occurring and there is risk to the marine environment; and
- ban the use of bores by placing memorials on titles.

Submissions

Concerns were raised by government agencies regarding nutrient levels in groundwater and the potential impact of the nutrients on the marine environment. Concerns were also raised regarding the presence of heavy metals and petroleum hydrocarbons in groundwater and the lack of monitoring for pesticides. The Water and Rivers Commission and the Department of Environmental Protection suggested that long-term monitoring of groundwater and fate and transport modelling of the contaminants should be undertaken to ensure that groundwater movement off-site poses no risk to the marine environment. The Water and Rivers Commission commented that modelling should be carried out to determine the capture zones of bores to ensure that contaminated groundwater is not abstracted.

Public submissions indicated that contaminated groundwater should be recovered and treated. Other submissions acknowledged that it was impracticable to fully remediate groundwater in the area and that groundwater quality would be improved once the source of contamination is removed. Concerns were also raised about the approach to managing groundwater contamination by restricting its use.

Assessment

The area considered for assessment of this factor is the groundwater underneath and down gradient of land along the Owen Anchorage coastline in South Coogee, approximately 5km south of Fremantle.

The EPA's environmental objective for this factor is to maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993).

The EPA considers that groundwater quality will be improved significantly, if the sources of contamination present both in the soil and at the water table are removed. The EPA notes the advice of the Department of Environmental Protection and the Water and Rivers Commission that the free phase hydrocarbon product at the water table at lots 23, 31, 34 and 51 should be removed.

The EPA notes that the groundwater beneath the project area has elevated levels of nitrate and, although acceptable for irrigation purposes in relation to nitrate levels, poses a risk to the marine environment, if contaminated groundwater enters it. The EPA believes that the proponent should carry out groundwater monitoring upgradient and downgradient of the project area to assess whether nutrient levels beneath the project site is a contributory factor to the nutrient loads discharged to the marine environment. The EPA notes the advice of the Water and Rivers Commission that further monitoring should occur on lot T/L2076 to verify the unexpected presence of mercury in groundwater beneath that site and that additional monitoring for pesticides should be carried out.

The Department of Environmental Protection advised that contaminated groundwater may affect the marine environment via groundwater discharge. The EPA notes that groundwater contamination has occurred beneath some sites and that the contamination, with the exception of lot 31, where contamination has moved off-site, is generally localised. The EPA believes that the best practical approach to manage the groundwater contamination plumes is to monitor and undertake fate and transport modelling which can be used to predict the behaviour of the plume and therefore assess any likely impacts on the marine environment. Therefore, the EPA considers that groundwater fate and transport modelling should be carried out for lots 31, 34, 35 and 51 to predict the risk of contaminants being transported to the marine environment.

The EPA also believes that should groundwater fate and transport modelling indicate that there is potential for the discharge of contaminated groundwater to the marine environment, a contingency plan should be prepared and implemented to reduce the impact to or below acceptable levels.

In summary, the EPA considers that the proposal to remove the source of contamination, such as contaminated soil and free floating hydrocarbon product from the water table, is the minimum to reduce groundwater contamination. There is insufficient information to determine

if removal of the source of contamination will be adequate to ensure acceptability. The proponent should undertake further investigation and prepare an Environmental Management Programme which would address the following issues (recommended Environmental Condition 4, Appendix 5):

- groundwater monitoring and definition of contaminated groundwater plumes;
- groundwater fate and transport modelling;
- groundwater pump tests to determine capture zones of domestic bores;
- groundwater remediation;
- groundwater validation; and
- contingency plan.

In response to public submissions, the proponent has made commitments to undertake additional groundwater monitoring (Commitments 5 and 21), carry out fate and transport modelling and prepare a contingency plan (Commitment 3 and 4), and undertake groundwater validation (Commitment 1 and 19).

Summary

Having particular regard to the:

- (a) groundwater remediation and management proposed;
- (b) proponent's commitments to remove free phase hydrocarbons, undertake further groundwater monitoring, undertake leachate tests on flyash, carry out fate and transport modelling, prepare a contingency plan should fate and transport modelling indicate that contaminated groundwater poses a risk to the marine environment and undertake groundwater validation; and
- (c) the advice of the Water and Rivers Commission and the Department of Environmental Protection,

it is the EPA's opinion that there is insufficient information available to determine if the proposal is acceptable. However, subject to further investigations and undertaking of remedial action, if required, to meet the groundwater quality objectives which is to maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993), the project is capable of meeting the EPA's objective.

3.3 Marine water and sediment quality

Description

The discharge of contaminated groundwater poses a risk to marine water quality. The marine environment of Owen Anchorage will be maintained by ensuring the water quality is within guidelines set for the protection of aquatic ecosystems, as defined in the South Metropolitan Coastal Waters Study (SMCWS) (DEP, 1996a).

With the exception of low levels of arsenic found in the sediments located near the shoreline north of Ahoy Road up to the northern boundary of the proposed development, heavy metals were below the Effects Range Low (ERL) levels (8.2mg/kg) established by the Department of Environmental Protection to meet Environmental Quality Objective EQO 2 Class II criteria for the maintenance of aquatic ecosystems (Figure 5). The source of arsenic is believed to be attributable to the past activities of tanneries that operated within the South Coogee area.

The low arsenic levels (range <1 to 24 mg/kg) only marginally exceed the ERL criteria. Arsenic levels in the sediments did not exceed the Effects Range Medium (ERM) criterion (70mg/kg) above which remediation is normally required.

The proposed approach to sediment management is:

- to reassess those areas identified in excess of the ERL by undertaking further monitoring including the form of arsenic; and
- to determine whether the sediments pose a likelihood of probable biological effects, if so a sediment monitoring program assessing effects on aquatic life would be undertaken.

Submissions

Submissions from government agencies commented that more information was required on sediment contamination and marine water quality. Submissions indicated that there was a need to determine the bioavailability of the contaminants present in sediments. The Department of Environmental Protection indicated that the sediment quality should be compared to the South Metropolitan Coastal Water Study "Draft environmental quality criteria for selected heavy metals and organic toxicants in sediments for the maintenance of ecosystem integrity" (DEP, 1996a).

Concerns were also raised by government agencies regarding the lack of detail on the potential of nutrients to affect marine water quality as a result of nutrient export via groundwater discharge.

Public submissions suggested that ongoing monitoring of marine sediment and water quality should occur and expressed concern about the lack of detail on the extent and nature of contamination of marine sediments. It was also suggested that contaminated sediments should be remediated by the proponent.

Assessment

The area considered for assessment of this factor is the marine water and sediment downgradient of the project land along the Owen Anchorage coastline in South Coogee, approximately 5km south of Fremantle.

The EPA's environmental objective for this factor is to maintain or improve marine water and sediment quality consistent with Environmental Quality Objectives (EQO's) and Environmental Quality Criteria (EQC's) defined in the Southern Metropolitan Coastal Waters Study.

The EPA considers that the low levels of arsenic found in marine sediments near the shoreline north of Ahoy Road appear to be elevated when compared to data presented for sediments more distant from that area. The EPA recognises that the source of contamination could possibly be due to past activities of tanneries that operated in the South Coogee area.

The EPA notes that the arsenic levels marginally exceed the ERL levels, but are below the ERM levels, above which level remediation is required. The EPA considers that on advice of the Department of Environmental Protection further information, including determining the form of arsenic, is required to assess the significance of the presence of arsenic at these levels. The EPA considers that additional sediment monitoring is required where arsenic levels exceed the ERL but are below the ERM criteria established by the DEP to meet EQO Class II criteria.

In summary, the EPA considers that the proposal to reassess the offshore sediment within the project area and to determine the fate of arsenic in the marine environment will ensure that low levels of arsenic in the sediments do not pose a risk to the marine environment. The EPA also considers that the proposal to remediate the marine sediments can be managed provided that the proponent prepares an Environmental Management Programme which would include the preparation of a marine sediment and water quality management plan (recommended Environmental condition 4, Appendix 5).

The EPA also notes that, in response to public submissions, the proponent has made commitments to undertake additional sediment monitoring and to reassess data (Commitment 23, 24 and 25).

Summary

Having particular regard to the:

- (a) proposed marine sediment and water quality remediation ;
- (b) proponent's commitments to undertake further investigation of marine sediments and to implement a sediment monitoring programme;
- (c) undertake remedial action, if required; and
- (d) the advice of the Department of Environmental Protection,

it is the EPA's opinion that there is insufficient information available to determine if the proposal is acceptable. However, subject to further investigations and undertaking of remedial action, if required, to meet marine sediment and water quality consistent with EQO's and EQC's defined in the Southern Metropolitan Coastal Water Study, the project is capable of meeting the EPA's objective.

4. Conditions and commitments

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

In developing recommended conditions for each project, the EPA's preferred course of action is to have the proponent provide an array of commitments to ameliorate the impacts of the proposal on the environment. The commitments are considered by the EPA as part of its assessment of the proposal and, following discussion with the proponent, the EPA may seek additional commitments.

The EPA recognises that not all of the commitments are written in a form which makes them readily enforceable, but they do provide a clear statement of the action to be taken as part of the proponent's responsibility for, and commitment to, continuous improvement in environmental performance. The commitments, modified if necessary to ensure they are enforceable, then form part of the conditions to which the proposal should be subject, if it is to be implemented.

4.1 Proponent's commitments

The proponent's commitments as set in the CER and subsequently modified, as shown in Appendix 3, should be made enforceable conditions.

4.2 Recommended conditions

Having considered the proponent's commitments and the information provided in this report, the EPA has developed a set of conditions which the EPA recommends be imposed if the proposal by the Western Australian Planning Commission to remediate the 50.56 hectares of government land along Owen Anchorage coastline in South Coogee, approximately 5km south of Fremantle, is approved for implementation. These conditions are presented in Appendix 5. Matters addressed in the conditions include:

- (a) the proponent shall fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 5;
- (b) requirement for an Environmental Management Programme (recommended Environmental Condition 4); and
- (c) requirement for the management of flyash (recommended Environmental Condition 6).

5. Other Advice

A formal Project Agreement between the WAPC and Port Catherine Developments Pty Ltd (PCD), defines government and developer responsibilities in order to facilitate the development of Port Catherine. Under the terms of the Project Agreement, the WAPC is required to remediate and assemble the government land within the project area for acquisition by PCD. PCD is to obtain the necessary approvals to develop the land. This agreement was endorsed by the Western Australian Cabinet in May 1997.

The current assessment is about the remediation of contaminated government-owned land which also includes an offshore development area as part of the Port Catherine Development (PCD). This is being assessed as a proposal under Section 38 of *the Environmental Protection Act 1986*. The s38 assessment does not include non-government land (Figure 2). The Western Australian Planning Commission own the government land and when remediated, will be sold to PCD. The s38 assessment considers remediation in general terms for the purpose of allowing the remediated land to be used for residential purposes, but recognising that not all of it will necessarily be used for residential purposes.

The assessment of rezoning of the entire area from industrial to residential is being undertaken as a scheme amendment under Section 48A of the Environmental Protection Act 1986 and provides for:

- (a) a change of zoning from industrial to urban to allow for residences (and some other use);
- (b) a marina;
- (c) the remediation of contaminated land in areas owned by PCD.

Accordingly the s48A assessment of the scheme amendment includes all of the area considered under the s38 assessment of the proposal to remediate government-owned land. It needs to be clearly established that the liability in relation to the remediation of contamination of government-owned land, or any residual contamination which might be found later, is passed from the WAPC to the PCD. In fact, the arrangements between the WAPC and the PCD are matters for those two parties, but there are environmental implications if the arrangements are not properly put into place to ensure that there is no doubt that legal liability transfers from one party to the other. It is essential that the remediation of both areas is implemented in an integrated manner.

Accordingly, the Minister for the Environment should have as a condition of approval, that because of the environmental implications, that the transfer of liability be to her satisfaction.

The EPA recommends that the WAPC includes transitional arrangements to transfer legal liability for the ongoing environmental management for this land within the Port Catherine project area post remediation, when transferred to Port Catherine Development. Through this transfer of land to PCD, PCD will be responsible for the long-term environmental management in accordance with the Environmental Conditions and Proponent Commitments set out in this report (Appendix 5).

6. Conclusions

The EPA has considered the proposal by the Western Australian Planning Commission to remediate portions of the 50.56 ha of government land along Owen Anchorage coastline in South Coogee, approximately 5km south of Fremantle, and has concluded that there is currently insufficient information available to determine if the proposal is acceptable. However subject to further investigations and satisfactory implementation by the proponent of the recommended conditions set out in Appendix 5 which includes the proponent's commitments, the proposal is capable of meeting the EPA's objective.

The EPA considers that the proposal to remove the source of contamination, such as soil and free floating hydrocarbon product from the water table, is the minimum to reduce groundwater contamination.

The EPA notes that this proposal will form part of the overall Port Catherine Development proposal but considers that the recommendations for this proposal do not pre-empt any recommendations or conclusions that the EPA may have, as a result of the assessment of the Port Catherine Development proposal.

7. Recommendations

Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister notes that the project being assessed is for the remediation of portions of 50.56 ha of government land along the Owen Anchorage coastline in South Coogee.
2. That the Minister considers the report on the relevant environmental factors as set out in Section 3;
3. That the Minister notes that further investigations of soil, groundwater and sediment quality are to be undertaken to demonstrate the full extent and level of contamination at the site and to determine the environmental and health risk posed to public health and the environment, if the proposed methods of remediation are to be implemented;
4. That the Minister notes that it is the EPA's opinion that there is currently insufficient information available to determine if the proposal is acceptable. However subject to further investigations and satisfactory implementation by the proponent of the recommended conditions set out in Appendix 5 which includes the proponent's commitments, the proposal is capable of meeting the EPA's objective.
5. That the Minister imposes the conditions and procedures recommended in Appendix 5 of this report.

Appendix 1

List of submitters

Organisations:

Conservation Council
Port Catherine Development
Coogee Chemicals
City of Cockburn
Port Catherine Development- BBG
Water and Rivers Commission

Individual:

Mr Crook

Appendix 2

References

- ANZECC/NHMRC (1992). *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*. January 1992.
- BBG (1998). *Port Catherine Project: Site Contamination Assessment and Management Program*, January 1998. Report No M17072.
- CMPS &F (1998). *Remediation of Contaminated Land for Residential Purposes, South Coogee*. Consultative Environmental Review Report April 1998.
- Davidson WA (1995). *Hydrogeological and Groundwater Resources of the Perth Region, Western Australia*. Western Australian Department of Mines, Perth.
- DEP (1996a). *Southern Metropolitan Coastal Waters Study*. Department of Environmental Protection, Report No 17, November 1996.
- DEP (1996b). *Landfill Waste Classification and Waste Definition..* Department of Environmental Protection, September, 1996.
- Environmental Protection Authority (EPA) (1993) *Draft Western Australian Water Quality Guidelines for Fresh and Marine Waters*. Environmental Protection Authority Bulletin 711, October 1993.
- Environmental Protection Authority (EPA) (1997). *A Site Remediation Hierarchy for Contaminated Sites*. July 1997. Interim Policy No. 17.
- GTA (1994). *Hydrogeological Investigation Summary Report South Coogee, WA*. Report No W9170, November 1994.
- SKM (1993). *Preliminary Site Assessment , South Coogee*. Sinclair Knight Mertz for Department of Resources Development. February, 1993.
- SKM (1994a). *Contaminated Site Assessment: Lot 34 Final report, Coogee Chemicals*. November, 1994.
- SKM (1994b). *Contaminated Site Assessment: Lot 27, 27/2, 35, 36 .* Final Report, September, 1994.
- SKM (1994c). *Contaminated Site Assessment: Lot 22*. Draft report, August, 1994.
- SKM (1995). *Contaminated Site Assessment: Lot 1755*. Draft Report, January, 1995.
- SKM (1997a). *Hydrogeological Investigation: Lot 34, South Coogee*. April, 1997.
- SKM (1997b). *Environmental Site Investigation: Lot 33 Ahoy Road*. Draft Report September, 1997.
- SKM (1997c). *Remediation Investigation: Lot 31 and 23*. Final Report, November, 1997.
- SKM (1998). *Remediation Investigation: Lot 2*. Draft Report, January 1998.

Appendix 3

Summary of identification of relevant environmental factors

Appendix 3: Summary of Identification of Relevant Environmental Factors

Preliminary Environmental Factor	Proposed characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
Pollution Management			
<p>Soil contamination</p>	<p>The proponent proposes to remediate portions of the 50.56ha of government land along the Owen Anchorage coast line in South Coogee, approximately 5 km south of Fremantle. Land has been contaminated due to past industrial activities including a tannery, fellmonger, oil processing, and flyash disposal.</p> <p>The type of contamination is principally heavy metals and in particular, arsenic, chromium, copper and zinc.</p>	<p>Government Agencies:</p> <p>Water and Rivers Commission</p> <ul style="list-style-type: none"> Concerned about the lack of data on the number of samples analysed for hydrocarbons, organophosphorus and organochlorines; Concerned about the uncertainty in the estimates of the amount of material to be remediated; Concerned about the contamination beneath the existing buildings; and Health Risk Assessment (HRA) modelling should be carried out for hydrocarbons and pesticides present in-situ in soil. <p>Department of Environmental Protection</p> <ul style="list-style-type: none"> Concerned about the lack of discussion on treatment options for waste material on the lots; Supports the use of site-specific criteria derived from HRA to predict potential risk; No indication of the timeframe for the HRA studies; and ANZECC environmental 'B' levels should be used as first criteria for clean-up levels. <p>Public:</p> <p>Conservation Council</p> <ul style="list-style-type: none"> Concerned about the rehabilitation of the site after remediation; and No mention of contingency plans for unexpected contamination. 	<p>Considered to be a relevant environmental factor</p>
	<p>The remediated industrial land will form part of the Port Catherine Development in South Coogee and will be developed for residential purposes.</p> <p>The remediation proposal involves:</p> <ul style="list-style-type: none"> removal of top 2 to 3 metres contaminated soil exceeding ANZECC 'B' or Dutch 'B' criteria to landfill; covering contaminated material with a 1 meter cover of clean fill for areas contaminated with flyash only; and reuse soil with contaminants levels less than ANZECC 'B' as fill elsewhere across the redevelopment. 		

Preliminary Environmental Factor	Proposed characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
		<p>Coogee Chemicals</p> <ul style="list-style-type: none"> Concerned about the remediation of lot 34 Ahoy Road and questions the accuracy of prediction of contaminated material on site. Concerned about the proposed remediation strategy for the elevated levels of copper present on lot 34 Ahoy Road. <p>City of Cockburn</p> <ul style="list-style-type: none"> Concerned about how clean-up criteria will be applied to various sites; Need to discuss the HRA procedures and management strategies to be used in remediation; Concerned about the lack of investigation data to assess the extent of contamination; Prefers that flyash be removed from the identified sites; <p>Port Catherine Development</p> <ul style="list-style-type: none"> Insufficient site investigation carried out; Further investigation required of lots 22, 23, 27, 37, and 9474; Lack of detail on flyash areas; No clean-up levels specified; Does not support leaving contaminated material below surface at a depth on site; and Concerned about the treatment of disused discharge pipes and drains. 	
Groundwater quality	<p>Groundwater quality has been contaminated with heavy metals, nutrients and hydrocarbons at a number of the sites within the 50.56ha of land.</p> <p>Contamination of the underlying groundwater has the potential to affect the marine environment.</p> <p>Contaminated groundwater has also affected</p>	<p>Government Agencies:</p> <p>Water and Rivers Commission</p> <ul style="list-style-type: none"> Concerned about the nutrient levels in groundwater at the animal product and food sites; Recommends that a HRA should be carried out on contaminated (pesticides) groundwater used for irrigation; Fate and transport modelling should be carried out on groundwater where the contaminant levels exceed the irrigation criteria; 	Considered to be a relevant environmental factor

Preliminary Environmental Factor	Proposed characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
	<p>water supply used for domestic and irrigation purposes.</p> <p>The remediation proposal involves:</p> <ul style="list-style-type: none"> • removal of source of contamination from groundwater, in particular free phase hydrocarbons; and • banning the use of groundwater for domestic and irrigation supplies; • groundwater extraction, treatment and containment, if necessary. 	<ul style="list-style-type: none"> • Free phase product contaminants need to be further investigated and remediated; and • Groundwater modelling should be carried out to determine the capture zones of bores to ensure that contaminated groundwater is not abstracted. <p>Department of Environmental Protection</p> <ul style="list-style-type: none"> • Off-site monitoring and fate and transport modelling of contaminants needed; • More information required regarding the proposed treatment of groundwater; • Concerned about the lack of monitoring for pesticides; • Concerned about the level of nutrients under the animal product sites; and • More information required on groundwater flow and potential impact of contaminants on marine water quality. <p>City of Cockburn</p> <ul style="list-style-type: none"> • Concerned about the long term responsibility for the sites. • Concerned about the approach to managing groundwater contamination in terms of restricting its use • Concerned about the lack of modelling to determine the potential impact of contaminated groundwater on the marine environment <p>Public:</p> <p>Conservation Council</p> <ul style="list-style-type: none"> • Contaminated groundwater should be recovered and treated. <p>Coogee Chemicals</p> <ul style="list-style-type: none"> • Agrees with the proposed remediation strategy for groundwater under lot 34 Ahoy Road <p>Port Catherine Development</p> <ul style="list-style-type: none"> • Does not want constraints on use of water or waterways due to lack of remediation of contaminated groundwater; and 	

Preliminary Environmental Factor	Proposed characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<p>Marine water and sediment quality</p> <p>The offshore sediments are generally free of contamination with the exception of low levels of arsenic located near the shoreline north of Ahoy Road up to the northern boundary of the redevelopment.</p> <p>The concentrations were above the DEP's draft Effects Range Low (ERL) criteria recommended for the maintenance of the ecosystem. However all concentrations were below the Effects Range Medium (ERM) criteria recommended as a target value for management intervention.</p> <p>Remedial action plan only if required.</p>	<ul style="list-style-type: none"> • Lack of information on responsibility for groundwater monitoring; • Acknowledges that it is impracticable to remediate groundwater, however expects groundwater quality to be improved by removing the source; • No detail provided on the contingency plan referred to in proposal; • Proponent should be responsible for monitoring and preparing contingency plans; • PCD will not accept liability or responsibility for any contingency plan in regard to the management of contaminated groundwater; <p>Government Agencies:</p> <p>Water and Rivers Commission</p> <ul style="list-style-type: none"> • No data on the synergistic and bioaccumulation effects of contaminants that exceed criteria set for the maintenance of the aquatic ecosystem; • No data on the bioavailability of contaminants; • Further investigation of the extent of mercury contamination should be carried out; • Need to determine the potential impact of contaminated groundwater on the marine environment; and • Need to determine the bioavailability of the contaminants present in sediments. <p>Department of Environmental Protection</p> <ul style="list-style-type: none"> • More information required on sediment contamination; • Sediment quality should be assessed against ERL and ERM values to determine the potential impact of contaminated sediment on the marine environment; • Marine sediment quality should be compared to the Southern Metropolitan Coastal Waters Study "Draft environmental quality criteria for selected heavy metals and organic toxicants" 		

Preliminary Environmental Factor	Proposed characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
		<p>in sediments for the maintenance of ecosystem integrity”;</p> <ul style="list-style-type: none"> • Concerned that only surface sediments were tested; • No data on the current marine water quality adjacent to the contaminated land; • No detail of the potential impact of nutrients on marine water quality as a result of nutrient export to the marina; and • No data on the rate of exchange or flushing within the marina. <p>City of Cockburn</p> <ul style="list-style-type: none"> • Ongoing monitoring of sediment and marine species should occur; • Concerned about the lack of detail on the extent and nature of contamination of marine sediments; • Concerned about the ongoing assessment and management of marine water quality; and <p>Public:</p> <p>Port Catherine Development</p> <ul style="list-style-type: none"> • Contaminated sediments should be remediated by West Australian Planning Commission; and • Proponent should clean-up contaminated marine sediments. 	
Air Quality			

Preliminary Environmental Factor	Proposed characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<p>Dust</p>	<p>There is a minimum buffer distance of approximately 400 meter between the nearest contaminated site and the residential area.</p> <p>The proposal may generate dust during:</p> <ul style="list-style-type: none"> • movement of trucks and earthmoving equipment; • disturbed land and dry soil conditions in conjunction with strong sea breeze; and • excavation activities during site remediation. 	<p>Conservation Council</p> <ul style="list-style-type: none"> • Concerned about dust emission from the stockpiles. <p>Public:</p> <p>City of Cockburn</p> <ul style="list-style-type: none"> • Dust Management Plan should be produced; 	<p>Dust management for both transport off-site and during remediation of the site is the same.</p> <p>Proponent commitments</p> <p>Prepare Dust Management Plan including:</p> <ul style="list-style-type: none"> • dust control measures approved by the DEP; • dust monitoring using high volume air samplers; • covering of truck carting contaminated material; • hydro mulching of stockpile area; • drainage management to control runoff of contaminated water; • wind fencing where necessary to minimise dust generation; • clean machinery used in excavations prior to leaving the site; • off-site dust control; and • compliance with DEP's guideline for the prevention of dust and smoke pollution-Nov 96 - "Land development sites and impacts on air quality". <p>Therefore, this factor can be adequately managed via proponent commitments.</p> <p>Not considered to be a relevant environmental factor.</p>

Preliminary Environmental Factor	Proposed characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<p>Noise</p>	<p>There is a minimum buffer distance of approximately 400 meter between the nearest contaminated site and the residential area.</p> <p>The proposal will generate noise during:</p> <ul style="list-style-type: none"> • movement of trucks and earthmoving equipment; • excavation activities during site remediation. 	<p>The issue of noise control was not raised in the public and government submissions.</p>	<p>Proponent commitments:</p> <p>Prepare Noise Management Plan including:</p> <ul style="list-style-type: none"> • good working equipment with effective silencers; • comply with Worksafe WA requirements for occupational noise exposure; and • comply with Environmental Protection (Noise) Regulations 1997. • noise monitoring and mitigation measures; • This factor can be adequately managed via proponent commitments. <p>Not considered to be a relevant environmental factor.</p>
<p>Vibration</p>	<p>There is a minimum buffer distance of approximately 400 meter between the nearest contaminated site and the residential area.</p> <p>The proposal will generate vibration during:</p> <ul style="list-style-type: none"> • movement of trucks and earthmoving equipment; and • compaction during site remediation. 	<p>The issue of vibration control was not raised in the public and government submissions.</p>	<p>Proponent commitments:</p> <ul style="list-style-type: none"> • comply with AS2670.2 (1990) to assess the level and impact of vibration; • monitor vibration near residential areas. <p>This factor can be adequately managed via proponent commitment.</p> <p>Not considered to be a relevant environmental factor.</p>

Preliminary Environmental Factor	Proposed characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
SOCIAL SURROUNDINGS			
Road Traffic Safety -	The proposal will involve a slight increase in traffic volumes in Cockburn Road, however this increase will be minimal. The road is currently classified as a main road which experiences substantial heavy haulage and approximately 16 000 vehicles per week day.	<p>City of Cockburn:</p> <ul style="list-style-type: none"> Management plan for the transport of contaminated material to landfill is required. 	<p>Proponent commitments:</p> <p>Prepare transport management plan including:</p> <ul style="list-style-type: none"> cover requirements for trucks carting contaminated materials; identify destination of proposed landfills; use roadworthy vehicles, underload and comply with the road Traffic Act (1974); determine transport routes in consultation with the DEP, Main Roads WA, Police and City of Cockburn . <p>This factor can be adequately managed via proponent commitments.</p> <p>Not considered to be a relevant environmental factor.</p>
Public Amenity - Access to coast	Although unauthorised access during remediation work will be controlled by fencing the contaminated sites adjacent to the shoreline, coastal access will be maintained along the beach front at all times during the remediation.	<p>Public:</p> <ul style="list-style-type: none"> Concerned about the rezoning of part of Coogee Beach and the loss of environmental values. 	<p>Proponent commitments:</p> <ul style="list-style-type: none"> keep closure of beach fronts for remedial works to hours outside of weekends and public holiday periods using safety barrier fencing. <p>This factor can be adequately managed via proponent commitments.</p> <p>Not considered to be a relevant environmental factor.</p>

Appendix 4

Summary of assessment of relevant environmental factors

Appendix 4: Summary of Evaluation of Relevant Environmental Factors

Relevant Factor	Environmental Objectives	Assessment	Advice
Soil contamination	<ul style="list-style-type: none"> ensure that the rehabilitation of the site is to an acceptable standard compatible with the intended land use and consistent with appropriate criteria meets the objectives of the EPA's hierarchy approach for site remediation (EPA Guidance Statement No. 17) which is for contaminated material to: <ul style="list-style-type: none"> (a) be treated on-site and the contaminants reduced to acceptable levels; or (b) be treated off-site and returned for reuse after the contaminants have been reduced to acceptable levels. <p>Disposal to an approved landfill and 'cap and contain' isolation measures should only be used if the preferred approaches are not practicable and if undertaken in an environmentally acceptable manner.</p>	<ul style="list-style-type: none"> DEP and WRC advise that the extent and nature of contamination at some sites is unknown and further site investigations is required; DEP and WRC advise that further site investigation including lots 22, 33, 35, 50, 51, 43701 and TL2076 is required; DEP advise that further soil testing is required under building structures including those on lots 13, 22, 23, 31, 51 and 1755; DEP and WRC advise that the estimates of volume of contaminated material to be remediated need to be re-assessed following further site investigation; Removal of contaminated material from the site to appropriate landfill sites will reduce the source of contamination; DEP advise that contaminated soils is to be remediated to ANZECC 'B' criteria for residential landuse; Where ANZECC 'B' criteria is not available, the DEP advise that Dutch 'B' criteria should be used as clean-up criteria for residential landuse; The EPA believes that, if flyash is to be contained on-site, leachate tests on flyash is to be undertaken to demonstrate that leachate does not affect groundwater and the marine environment; Where contaminant levels at depth exceed the ANZECC 'B' or Dutch 'B' clean-up criteria, site-specific criteria derived from an environmental and health risk assessment may be acceptable as target levels for clean-up subject to approval from the EPA on advice of the Health Department of WA and DEP; DEP advise that lots 109, and reserve lots 43701 and T/L 2076 contaminated with flyash is to be remediated to Dutch 'B' criteria, if land is to be developed for 	<p>Having particular regard to:</p> <ul style="list-style-type: none"> (a) the WRC, DEP and Health Department advice; (b) the proponent's commitments; it is the EPA's opinion that there is insufficient information available to determine if the proposal is acceptable. However, subject to further investigations and satisfactory implementation by the proponent of the recommended condition 4 which require the proponent to prepare, prior to commencement of remediation of the site, an Environmental Management Programme, which provides details of: <ul style="list-style-type: none"> Soil investigation and sampling; Environmental and health risk assessment; Leachate tests on flyash; Stormwater management; Monitor air quality for VOCs, during remediation; Dust and noise management plan; Transport management plan. <p>and condition 6 which requires the proponent to:</p> <ul style="list-style-type: none"> remediate land, including lots 109 and Reserves 43701 and T/L 2076, contaminated with flyash to Dutch 'B' clean-up criteria, if it is to be developed for residential landuse; cover with at least 1 metre of clean fill, if flyash is to be contained on-site and

Relevant Factor	Environmental Objectives	Assessment	Advice
		<p>residential landuse;</p> <ul style="list-style-type: none"> Health Department of WA advise that, where it is proposed to contain flyash on site, a minimum cover of 1m clean fill is to apply and the sites should not be developed as residential land; Reuse of soil with low level contaminants below ANZECC 'B' levels as backfill is acceptable and will minimise the volume to landfill; The EPA considers that unless an environmental and health risk assessment is carried out, validation of the site to ANZECC 'B' criteria will ensure that the site is suitable for residential landuse; <p>Proponent Commitments:</p> <ul style="list-style-type: none"> undertake additional soil testing on WAPC lots 22, 33 and 35 Ahoy Road and lots 50 and 51 Cockburn Road. undertake an environmental and health risk assessment on WAPC lots 31, 34 and 35 Ahoy roads; undertake leachate testing on flyash to demonstrate if flyash poses a risk to the environment; monitor air quality for VOCs during remediation to ensure that contaminated soil does not pose a significant risk to the workers and the general public; implement a remedial validation program to demonstrate compliance with DEP site clean-up criteria; undertake validation of lots 36, 37 and 38 Ahoy Road, CR 1945, CR 11430, CR 24306, CR 43701 and T/L2076. show compliance to criteria in the form of a site remediation validation report; remove contaminated soil in accordance with the site management techniques described in CER and based on health risk assessment; dispose of contaminated material in accordance with DEP requirements; and 	<p>leachate tests indicate no risk to the environment.</p> <ul style="list-style-type: none"> not develop the flyash-covered areas for residential purposes or for use involving excavation such as infrastructure corridors for buried services, <p>the proposal is capable of meeting the EPA's objective.</p>

Relevant Factor	Environmental Objectives	Assessment	Advice
Groundwater quality	<ul style="list-style-type: none"> maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993) 	<ul style="list-style-type: none"> DEP and WRC advise that the free phase petroleum product at the water table at lots 23, 31, 34 and 51 should be removed; removal of this contaminant will significantly reduce the source of ongoing contamination of groundwater; DEP advise that the potential impact to the ecosystem is via groundwater discharge, therefore groundwater fate and transport modelling is required at lots 31, 34, 35 and 51 to predict the risk of contaminant transport to the marine environment; DEP advise that should groundwater fate and transport modelling indicate that there is potential for the discharge of contaminated groundwater to the marine environment, a contingency plan should be prepared and implemented to reduce the impact. WRC advise that the contaminated groundwater at lot 34 should be remediated to reduce the level of copper unless groundwater fate and transport modelling indicates that the copper does not pose a risk to the marine environment; DEP advise that groundwater monitoring should be carried out upgradient and downgradient of the project area to assess whether nutrients levels beneath the project site is a contributory factor to the nutrient loads discharged to the marine environment; WRC advise that further groundwater monitoring should occur on lot T/L 2076 to verify the unexpected presence of mercury; <p>Proponent Commitments:</p> <ul style="list-style-type: none"> remove free petroleum product from groundwater from lots 23 and 31 Ahoy Road and lot 51 Cockburn Road; carry out groundwater validation on remediation of lots 23, 31 and 51 to ensure no observable free phase product exists; 	<p>Having particular regard to:</p> <p>(a) the WRC, DEP and Health Department advice;</p> <p>(b) the proponent's commitments; it is the EPA's opinion that there is insufficient information available to determine if the proposal is acceptable. However, subject to further investigations and satisfactory implementation by the proponent of the recommended condition 4 which requires the proponent to prepare, prior to commencement of remediation of the site, an Environmental Management Programme, which provides details of:</p> <p>Groundwater management plan including:</p> <ul style="list-style-type: none"> groundwater monitoring; groundwater fate and transport modelling including lots 31, 34, 35 Ahoy Road and 51 Cockburn Road; groundwater remediation including removal of free phase petroleum hydrocarbons from lots 23, 31, 34 and 51; groundwater tests to determine groundwater capture zones for domestic bores; groundwater remediation validation including lots 23, 31, 34 and 51; contingency plan for groundwater management should fate and transport modelling indicate a risk to the marine environment; <p>condition 5 which requires the proponent to place memorials on titles, prior to</p>

Relevant Factor	Environmental Objectives	Assessment	Advice
<p>Marine water and sediment quality</p>	<ul style="list-style-type: none"> maintain or improve marine water and sediment quality consistent with Environmental Quality Objectives (EQO's) and Environmental Quality Criteria (EQC's) defined in the Southern Metropolitan Coastal Waters Study (1996). marine water quality to comply with the maintenance of aquatic ecosystems (EQO 2) criteria and the maintenance of aquatic life for human consumption (EQO3) criteria; marine sediment quality to comply with the maintenance of aquatic ecosystems (EQO 2) Class II criteria. 	<ul style="list-style-type: none"> prepare and implement groundwater monitoring plan; prepare groundwater fate and transport modelling plan; undertake groundwater fate and transport modelling on contaminated groundwater from lots 31, 34, 35 Ahoy Road and 51 Cockburn Road. undertake additional groundwater testing on WAPC sites, in particular Lt 2076; undertake groundwater tests to determine groundwater capture zones for domestic bores; place memorials on title to prevent use of groundwater for irrigation; and prepare contingency plan if fate and transport modelling indicate groundwater is likely to impact on ecosystem. 	<p>subdivision, or sale of any existing lot to prevent the abstraction of groundwater for domestic use and,</p> <p>condition 6 which requires the proponent to undertake leachate tests on flyash to demonstrate that flyash does not pose a risk to groundwater and the environment,</p> <p>the proposal is capable of meeting the EPA's objective.</p>
	<ul style="list-style-type: none"> DEP advise that the levels of arsenic found in marine sediments near the old tannery sites appear to be elevated when compared against data presented for sediments more distant from the known tannery sites; DEP advise that further information, including the form of arsenic, is required to assess the significance of these elevated concentrations including the form; DEP advise that sediment monitoring is required where contaminant levels exceed the ERL but below ERM criteria established by the DEP to meet EQO 2 Class II criteria; DEP advise that a management plan should be developed for arsenic in sediments based on the results of the investigations mentioned above. <p>Proponent Commitments:</p> <ul style="list-style-type: none"> undertake additional sediment monitoring; monitor sediment quality and reassess based on refined guidelines as per DEP's SMCWA guidelines; and implement sediment monitoring program where contaminant levels exceed the refined sediment criteria. 	<p>Having particular regard to:</p> <p>(a) the WRC, DEP and Health Department advice;</p> <p>(b) the proponent's commitments;</p> <p>it is the EPA's opinion that there is insufficient information available to determine if the proposal is acceptable. However, subject to further investigations and satisfactory implementation by the proponent of the recommended condition 4 which requires the proponent to prepare, prior to commencement of remediation of the site, an Environmental Management Programme, which provides details of marine sediment and water quality management plan,</p> <p>the proposal is capable of meeting the EPA's objective.</p>	

Appendix 5

Recommended Environmental Conditions and Proponent's Consolidated Commitments

RECOMMENDED DRAFT MINISTERIAL CONDITIONS

**STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED
(PURSUANT TO THE PROVISIONS OF THE
ENVIRONMENTAL PROTECTION ACT 1986)**

REMEDICATION OF INDUSTRIAL LAND FOR RESIDENTIAL PURPOSES,
SOUTH COOGEE

- Proposal:** The remediation of portions of the 50.56 hectares of government land along Owen Anchorage coast line in South Coogee, approximately 5 km south of Fremantle for residential purposes as documented in schedule 1 of this statement.
- Proponent:** Western Australian Planning Commission
- Proponent Address:** 469-489 Wellington Street, Perth, Western Australia, 6000
- Assessment Number:** 1004
- Report of the Environmental Protection Authority:** Bulletin 957

The proposal to which the above report of the Environmental Protection Authority relate may be implemented subject to the following conditions and procedures.

1 Implementation

- 1-1 Subject to these conditions and procedures, the proponent shall implement the proposal as documented in schedule 1 of this statement.
- 1-2 Where the proponent seeks to change any aspect of the proposal as documented in schedule 1 of this statement in any way that the Minister for the Environment determines, on advice of the Environmental Protection Authority, is substantial, the proponent shall refer the matter to the Environmental Protection Authority.
- 1-3 Where the proponent seeks to change any aspect of the proposal as documented in schedule 1 of this statement in any way that the Minister for the Environment determines, on advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

2 Proponent Commitments

- 2-1 The proponent shall implement the consolidated environmental management commitments documented in schedule 2 of this statement.
- 2-2 The proponent shall implement subsequent environmental management commitments which the proponent makes as part of the fulfilment of conditions and procedures in this statement.

3 Environmental Management System

3-1 In order to manage the environmental impacts of the project, and to fulfil the requirements of the conditions and procedures in this statement, prior to ground disturbing activities, the proponent shall demonstrate to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection that there is in place an environmental management system which includes the following elements:

1. An environmental policy and corporate commitment to it;
2. Mechanisms and processes to ensure;
 - 2.1 planning to meet environmental requirements;
 - 2.2 implementation and operation of actions to meet environmental requirements;
 - 2.3 measurement and evaluation of environmental performance; and
3. Review and improvement of environmental outcomes.

3-2 The proponent shall implement the environmental management system referred to in condition 3-1.

4 Environmental Management Programme

4-1 Prior to ground-disturbing activities, the proponent shall prepare an Environmental Management Programme to achieve the following objectives:

- to ensure remediation meets EPA objectives for site contamination, groundwater quality and marine water and sediment quality, and
- to protect the groundwater, the marine environment and the amenity of the public during and post clean-up operations

to the requirements of the Environmental Protection Authority on advice of the Water and Rivers Commission, the Health Department of Western Australia and the Department of Environmental Protection.

This Programme shall contain the following environmental management plans:

Soil Investigation and Sampling Plan

1. to define the extent and nature of soil contamination at the sites including lots 22, 33, 35, 50, and 51 for heavy metals, hydrocarbons and pesticides;
2. to specify the details of tests to be performed and subsequently the results as well as their implications for site remediation;
3. to define the extent and nature of soil contamination specifically under building structures at the sites, including lots 13, 22, 23, 31, 51 and 1755;
4. to estimate the volume of soil to be disposed to landfill, based on site investigations and the class of landfill for disposal; and
5. to develop contingency plans in the event of additional contaminated material located on the various sites which may require off-site disposal or other remedial treatment;

Soil Remediation Validation Plan

6. details of site validation methods to demonstrate compliance with clean-up validation criteria specified in Condition 5 for soil;
7. site remediation validation results;

Environmental and Health Risk Assessment Plan

8. details of environmental and health risk assessment (HRA) process to be adopted (see commitment 2);
9. details of a contingency plan for soil management should HRA indicate a risk to public health and the environment.

Dust and Noise/Vibration Management Plan

A plan containing details of:

10. dust control measures;
11. dust monitoring and reporting;
12. dust suppression with water sprays on access roads and operational areas;
13. dust suppression for stockpiles;
14. wind fencing, where necessary;
15. clean down of machinery;
16. equipment type;
17. compliance with DEP guidelines and regulations and Australian Standards for dust, noise and vibration;

Transport Management Plan

A plan containing details of:

18. types of waste materials;
19. excavation and loading methods;
20. controls on vehicles for the transport of wastes;
21. types and roadworthiness of vehicles;
22. the routes for transport of wastes and the approvals from relevant authorities to use these routes;
23. documentation and records of wastes departure and destination; and
24. emergency response plan.

Groundwater Management Plan

25. Groundwater Monitoring

- details on additional groundwater monitoring (see commitment 5 and 21);
- details of additional groundwater monitoring for ammonia-nitrogen (see commitment 5);
- details of sample types, bore construction, sample locations, monitoring frequency, analytical protocols, parameters and reporting of monitoring results;
- the definition of the extent of groundwater contamination plumes;

26. Groundwater Fate and Transport Modelling

- leachate tests for contaminants which might be left on site;
- fate and transport modelling for lots 31, 34, 35 Ahoy Road and 51 Cockburn Road (see commitment 3);
- methodology for risk assessment based on fate and transport data obtained above;
- model validation;

27. Groundwater Remediation

- groundwater remediation procedures including removal of free phase petroleum hydrocarbons from the water table at lots 23, 31, 34 and 51;
- treatment or disposal method for any hydrocarbon or other waste generated and its compliance with environmental requirements;
- controls on groundwater use required
- bore capture zones both for on-site and off-site groundwater abstraction;

28. Groundwater Remediation Validation

- groundwater validation for lots 23, 31, 34 and 51;

29. Contingency plan

- a contingency plan for groundwater management should fate and transport modelling indicate a risk to the marine environment (commitment 4);

Marine Sediment and Water Quality Management Plan

- 30. sediment monitoring including sites, number of samples and tests to be performed (see commitment 23 and 24);
- 31. contingency plan for sediment management, if monitoring indicates a risk to the marine environment (commitment 25).

Stormwater Management Plan

- 32. provisions for stormwater management in areas with residential soil contamination during and after remediation;

Site Remediation Integration

- 33. integration with other site remediation programmes on nearby sites.

4-2 Prior to the development of the site for residential purposes, the proponent shall implement the environmental management programme required by condition 4-1 to achieve the objectives stated under condition 4-1, to the requirements of the Environmental Protection Authority on advice of the Department of Environmental Protection, Health Department of Western Australia and the Water and Rivers Commission.

5 Development of Site

- 5-1 Prior to the development of the site for residential purposes, the proponent shall carry out site remediation validation tests to demonstrate that the contaminant levels in soil do not exceed the Australian and New Zealand (ANZECC) 'B', or, Dutch 'B' criteria in the absence of ANZECC 'B' clean-up levels recommended for residential landuse.

Where contaminant levels at depth exceed the ANZECC 'B' or Dutch 'B' criteria in the absence of ANZECC 'B' criteria, site-specific criteria based on an environmental and/or health risk assessment may be acceptable as target levels for clean-up to the requirements of the Environmental Protection Authority on advice of the Health Department of Western Australia, the Water and Rivers Commission and the Department of Environmental Protection.

- 5-2 Prior to any subdivision, or sale of any existing lot, the proponent shall make provision for the placement of memorials by the appropriate authority on the titles of lots where **soil or** groundwater contamination exists under those lots to prevent the abstraction and use of groundwater, both for onsite and offsite bore locations.

6 Flyash Contamination

- 6-1 Where flyash and flyash contaminated material is to be contained on-site, the proponent, shall undertake leachate tests to demonstrate that leachate poses no significant risk to the groundwater. Should leachate results indicate that there is no risk to the environment and the flyash is to be contained on-site, the proponent shall apply a minimum cover of at least one metre of clean fill material (certified as not containing contaminants above soil criteria for residential use, see note 2 following condition 9) to the requirements of the Environmental Protection Authority on advice of the Health Department of Western Australia, WorkSafe Western Australia and the Department of Environmental Protection. The sites shall not be developed as residential land.
- 6-2 Where flyash and flyash-contaminated material is to be contained on-site, the proponent, developer, infrastructure provider or other person shall not cause or allow any excavation below the surface that may result in the significant disturbance of the flyash contamination.
- 6-3 Should the leachate tests indicate that there is risk to the environment and prior to development of the site, the proponent shall remediate lot 109 and Reserves 43701 and T/L 2076 contaminated with flyash to Dutch 'B' criteria for contaminants including barium, to a standard suitable for residential land use to the requirements of the Environmental Protection Authority on advice of the Health Department of Western Australia, WorkSafe Western Australia, the Water and Rivers Commission and the Department of Environmental Protection.

7 Proponent

- 7-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the Environmental Protection Act is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person in respect of the proposal.
- 7-2 Any request for the exercise of that power of the Minister referred to in condition 7-1 shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the proposal in accordance with the conditions and procedures set out in the statement.
- 7-3 The proponent shall notify the Department of Environmental Protection of any change of proponent contact name and address within 30 days of such change.

8 Commencement

- 8-1 The proponent shall provide evidence to the Minister for the Environment within five years of the date of this statement that the proposal has been substantially commenced.
- 8-2 Where the proposal has not been substantially commenced within five years of the date of this statement, the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment will determine any question as to whether the proposal has been substantially commenced.
- 8-3 The proponent shall make application to the Minister for the Environment for any extension of approval for the substantial commencement of the proposal beyond five

years from the date of this statement at least 6 months prior to the expiration of the five year period referred to in conditions 8-1 and 8-2.

- 8-4 Where the proponent demonstrates to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority that the environmental parameters of the proposal have not changed significantly, then the Minister may grant an extension not exceeding five years for the substantial commencement of the proposal.

9 Compliance Auditing

- 9-1 The proponent shall submit periodic Compliance Reports, in accordance with an audit programme prepared in consultation between the proponent and the Department of Environmental Protection.
- 9-2 Unless otherwise specified, the Chief Executive Officer of the Department of Environmental Protection is responsible for assessing compliance with the conditions, procedures and commitments contained in this statement and for issuing formal, written advice that the requirements have been met.
- 9-3 Where compliance with any condition, procedure or commitment is in dispute, the matter will be determined by the Minister for the Environment.

Note

1. "Remediation" in this statement means removal or rendering safe contaminants so that they no longer pose an unacceptable risk to human health or the environment. Areas remediated must be validated as such in accordance with a validation program approved by the Chief Executive Officer of the Department of Environmental Protection.
2. Soil criteria for residential use must comply with the following clean-up levels, in order of preference: ANZECC 'B' or Dutch B (in the absence of ANZECC 'B') or derived criteria based on site-specific Environmental and Health Risk Assessment.
3. "Ground-disturbing activities" excludes sampling and monitoring to determine the extent and nature of contamination.

Schedule 1

Remediation of portions of the 50.56 hectares of government land along Owen Anchorage coast line in South Coogee, approximately 5 km south of Fremantle for residential purposes.

Residential development of the site is included in the proposal.

Key Proposal Characteristics

Element	Description
SITE IDENTIFICATION	<p>The development site is government owned land in the Port Catherine Project area with an area of 50.56 ha along the Owen Anchorage coastline in South Coogee, approximately 5 km south of Fremantle.</p> <p>The project area includes : lots 2, 3, 4, 13, 51, 78, 1755, 9474 (Cockburn Road); lots 21, 22, 23, 27, 27/2, 31, 33, 34, 35, 36, 37 (Ahoy Road); lot 38 (King Street); lot 50 (Ocean Road); Reserves 24306,43701, 11430 and 1945, Town Lot(T/L) 2076; lot 109.</p>
CURRENT ZONING	Industrial
PROPOSED ZONING	Residential
DEMOLITION	Old buildings to be demolished and removed
NATURE OF CONTAMINANTS	<p>Soil: Heavy metals (arsenic, chromium, copper and zinc), petroleum hydrocarbons and flyash (barium).</p> <p>Groundwater: Heavy metals (copper, nickel), petroleum hydrocarbons and nitrate.</p> <p>Sediment: Heavy metal (arsenic).</p>
REMEDICATION and MANAGEMENT	
Soil	<ul style="list-style-type: none"> • remove approximately 52 000 m³ (80%) of contaminated soil which exceeds ANZECC 'B' or Dutch 'B' criteria and dispose to approved landfill; • remediate remaining 20% of contaminated soil at depth to site-specific criteria based on environmental and health risk assessment to the requirements of the EPA; • undertake leachate tests on flyash to assess the risk of contamination to groundwater, if flyash is to be contained on-site; • test contaminated soil for the likely generation of volatile organic carbons particularly at sites (lot 31, 34, 1755 and 9474) where petroleum hydrocarbons were detected; • monitor the volatile organic carbons levels during remediation at sites likely to pose a significant risk; • cover approximately 38 000 m³ (0.75 ha) of flyash with at least 1metre of clean fill, if leachate tests on flyash indicate no significant risk to the environment; • reuse soil with contamination levels less than ANZECC 'B' for backfill.

Groundwater	<ul style="list-style-type: none"> • remove completely free phase petroleum hydrocarbons contamination source from the water table; • conduct long-term monitoring of groundwater at plume sites and downgradient of plume; • conduct fate and transport modelling of particular contaminants in groundwater to determine risk posed to the marine environment; • undertake pumping tests to determine off-site impacts to domestic bore water quality by determining groundwater capture zones; • prepare and implement groundwater contingency plan, if groundwater monitoring, fate and transport modelling indicates a risk to the environment; • validate model with further groundwater monitoring; • ban the use of contaminated groundwater by placing memorials on titles;
Marine sediments	<ul style="list-style-type: none"> • monitor sediments and predict impact based on data; • identify arsenic form in sediments in excess of the Effects Range Low (ERL) criteria recommended for the maintenance of the ecosystem; • implement remedial contingency plan, if necessary.
Dust	<ul style="list-style-type: none"> • prepare and implement a dust management plan for both site works and transportation of contaminated material off-site.
Noise and vibration	<ul style="list-style-type: none"> • prepare and implement a noise management plan outlining noise mitigation measures and monitoring procedures.
Public safety and environmental health	<ul style="list-style-type: none"> • prepare and implement a public safety and environmental health plan.
Worker safety and occupational health	<ul style="list-style-type: none"> • prepare and implement an occupational health and safety plan.
Transport management	<ul style="list-style-type: none"> • prepare and implement a transport management plan.

Note:

- Figure 1: Location of WAPC residential development in South Coogee.
Figure 2: Government and non-government land.
Figure 3: Extent of soil contamination
Figure 4: Location of groundwater contamination in South Coogee.
Figure 5: Extent of arsenic sediment contamination.

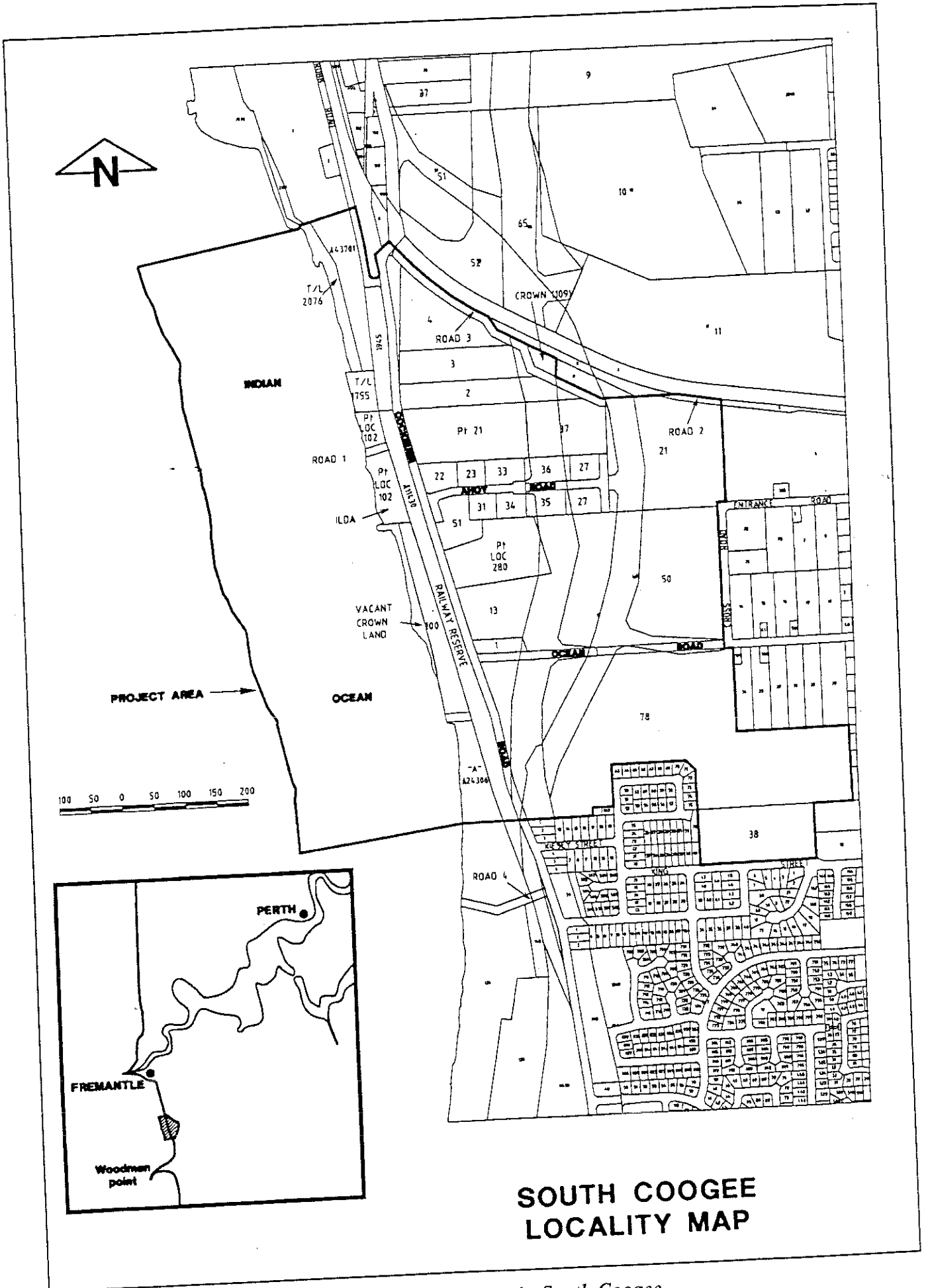
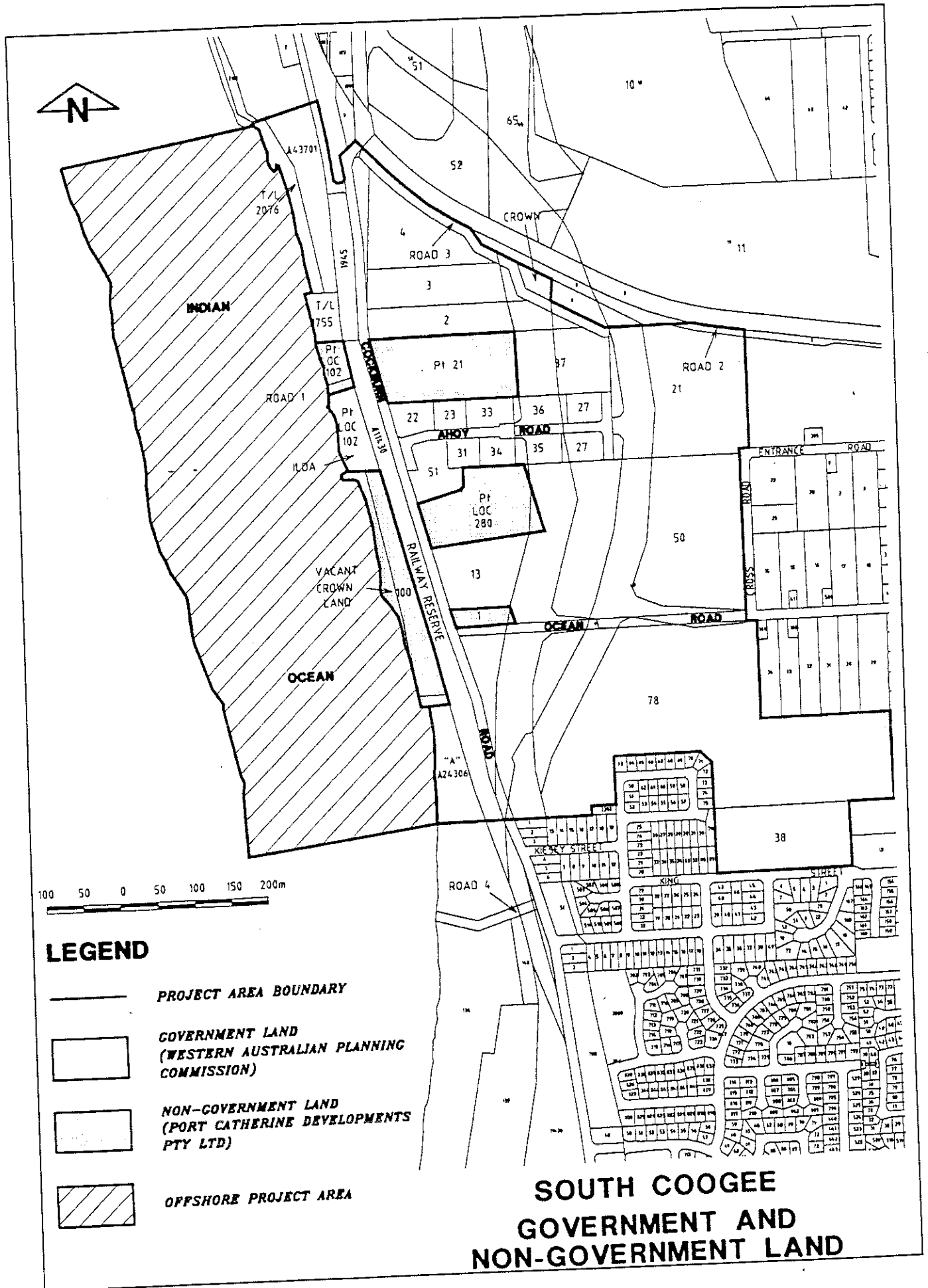


Figure 1. Location of WAPC residential development in South Coogee.



**SOUTH COOGEE
GOVERNMENT AND
NON-GOVERNMENT LAND**

Figure 2. Government and non-government land.

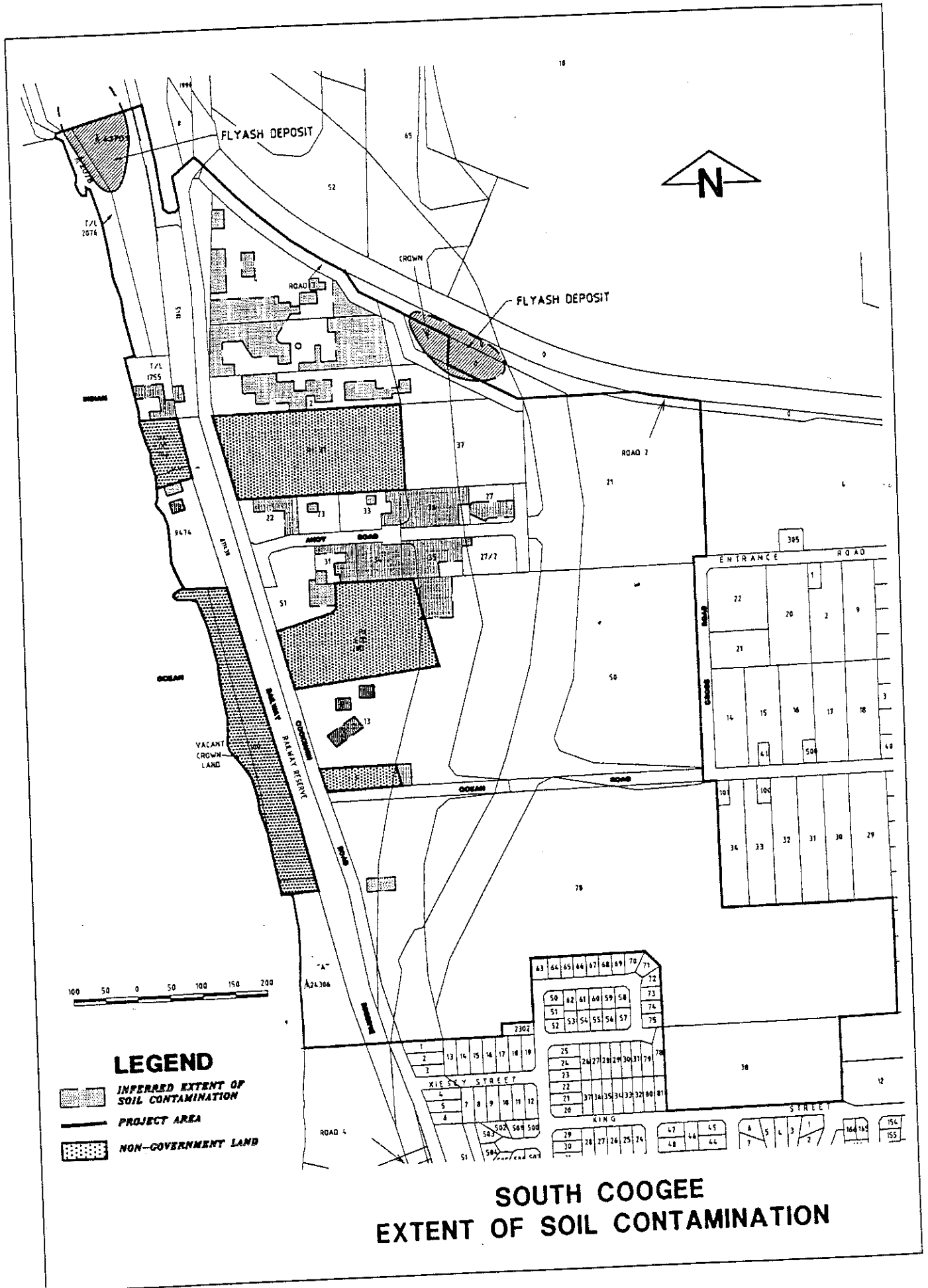


Figure 3. Extent of soil contamination.

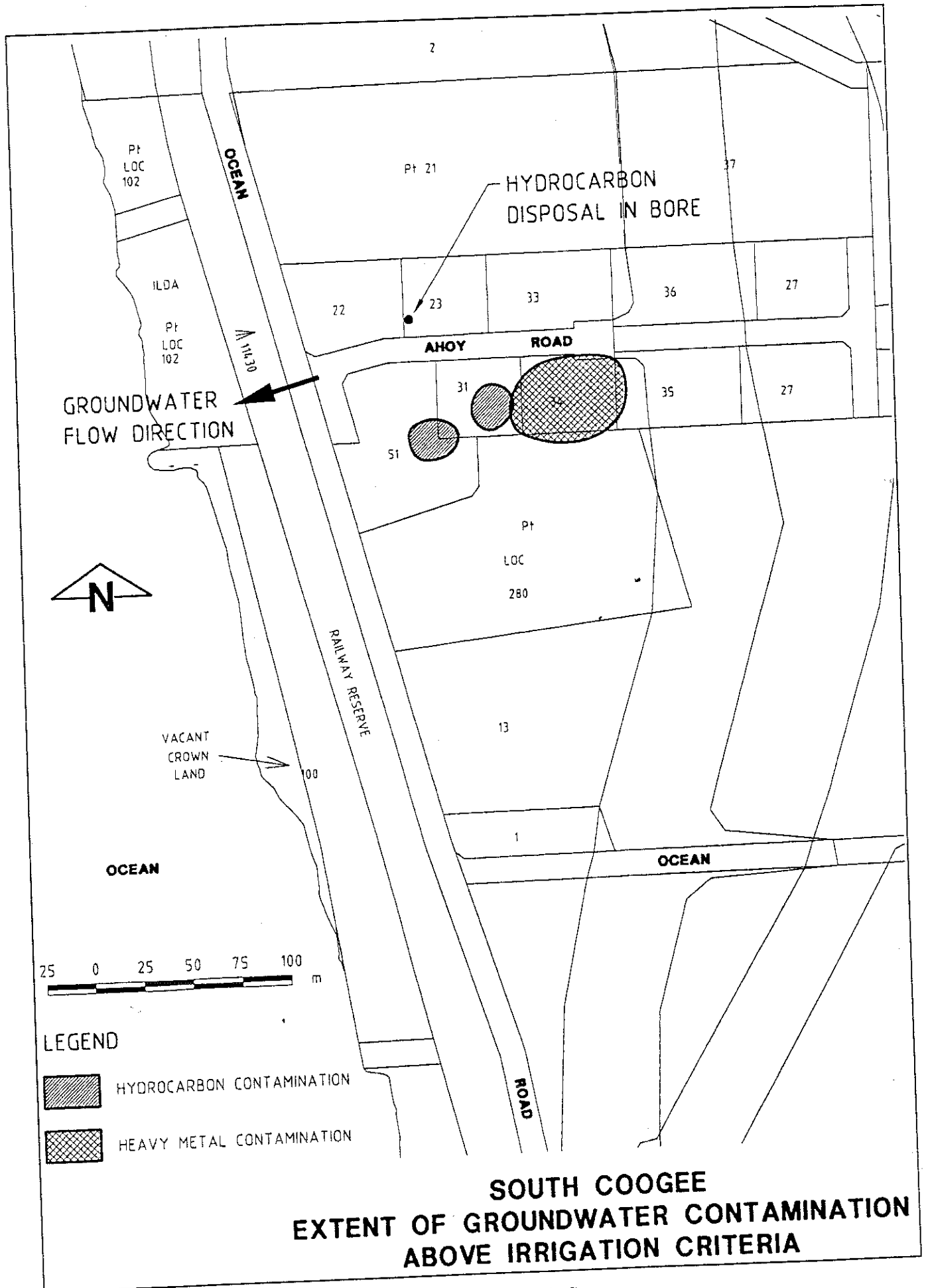


Figure 4. Location of groundwater contamination in South Coogee.

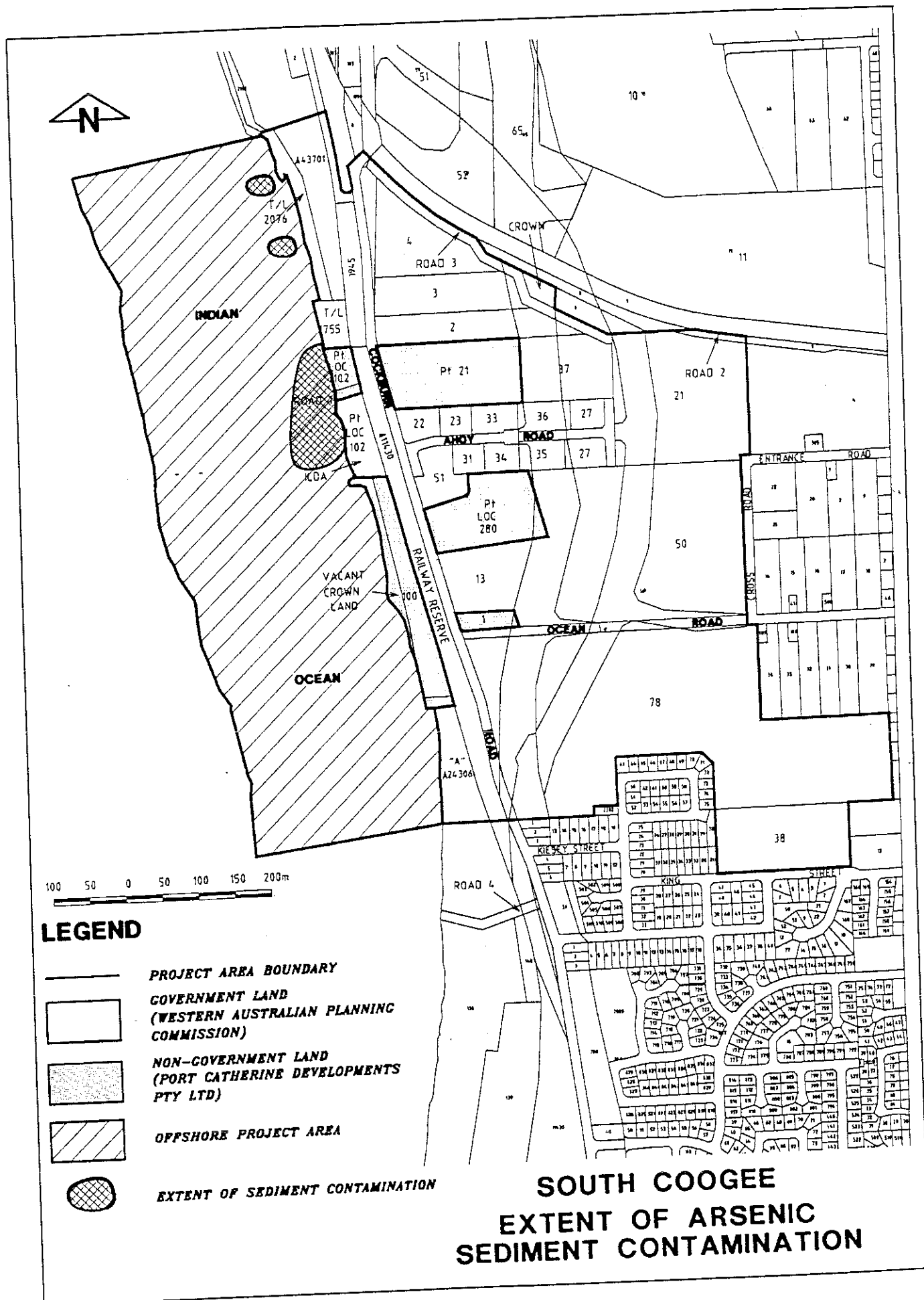


Figure 5. Extent of arsenic sediment contamination.

**Proponent's Consolidated Environmental Management
Commitments**

11 November 1999

**REMEDICATION OF INDUSTRIAL LAND FOR
RESIDENTIAL PURPOSES,
SOUTH COOGEE**

Western Australian Planning Commission

Proponent's Environmental Management Commitments (1004)

Commitment Number	Topic	Action	Objectives	Timing (Phase)	Advice (Advisory Agency)	To the requirements of (Monitoring Agency)
1.	Remediation Report	<ul style="list-style-type: none"> • Prepare a site remediation report 	<ul style="list-style-type: none"> • To remediate contaminated land and groundwater to the EPA criteria. • To apply the following soil remediation criteria hierarchy (1) ANZECC B, where no (1), (2) 1983 Dutch B, or criteria derived from a site specific environment and health risk assessment. • To recover free petroleum product floating on the water table to meet the EPA /DEP requirements. • To remediate Lots 31, 34 and 35 Ahoy Road to soil criteria developed from a site specific environmental and health risk assessment meeting EPA requirements. 	<p>During and at completion of remedial works.</p> <p>Remediation and post-remediation.</p>	<p>DEP</p> <p>HDWA</p> <p>WRC</p>	DEP

Commitment Number	Topic	Action	Objectives	Timing (Phase)	Advice (Advisory Agency)	To the requirements of (Monitoring Agency)
2.	Environmental and Health Risk Assessment	<ul style="list-style-type: none"> Undertake an environmental and health risk assessment on Lots 31, 34 and 35 Ahoy Road with contaminants to be assessed including chromium, copper, nickel, tin, zinc and total petroleum hydrocarbons. Prepare and implement a contingency plan in the event the risk assessment shows that significant health impacts are likely to occur as a result of the contaminant concentrations in the soil. 	<ul style="list-style-type: none"> To demonstrate that any residual contamination does not adversely affect the health of future residents, or compromise the marine environment or groundwater use. to determine the need for drainage management associated with any residual contamination. the impacts on groundwater use to put in place controls, if required, with respect to land use, site development or groundwater use. 	Pre-remediation.	DEP HDWA	DEP
3.	Groundwater Modelling	<ul style="list-style-type: none"> Undertake groundwater fate and transport modelling for copper, nickel and total petroleum hydrocarbons (as applicable) on contaminated groundwater emanating from Lots 31, 34, 35 Ahoy Road and Lot 51 Cockburn Road. 	<ul style="list-style-type: none"> To predict long term contaminant levels in groundwater at and downgradient of these sites to determine the area that should be excluded from groundwater abstraction 	Pre-remediation.	DEP WRC	DEP

Commitment Number	Topic	Action	Objectives	Timing (Phase)	Advice (Advisory Agency)	To the requirements of (Monitoring Agency)
4.	Groundwater Contingency Plan	<ul style="list-style-type: none"> Prepare a Groundwater Contingency Plan in the event that groundwater fate and transport modelling shows that significant environmental impacts are likely to occur as a result of the contaminant concentrations in groundwater entering the marine environment. This plan will describe measures to ameliorate such impacts, and consider practical management techniques and groundwater extraction, treatment and containment options. Implement the Groundwater Contingency Plan should groundwater fate and transport modelling show potential environmental impacts are likely to occur. 	<ul style="list-style-type: none"> To ensure that contaminated groundwater meets EPA criteria 	Pre-remediation.	DEP WRC	DEP

Commitment Number	Topic	Action	Objectives	Timing (Phase)	Advice (Advisory Agency)	To the requirements of (Monitoring Agency)
5.	Environmental Sampling	<ul style="list-style-type: none"> • Undertake additional soil investigations on Lots 13, 22, 23, 31, 33 and 35 Ahoy Road, Lot 50 Ocean Road, Lots 51 and 1755 Cockburn Road and T/L2076 which will include testing beneath any existing building structures. • Review the organochlorine testing program undertaken to date (28/10/99) and perform additional testing on sites where required. • Retest groundwater on T/L 2076 for mercury. • Install three groundwater monitor wells along the eastern boundary of the project area and test for the nutrient - nitrate. • Perform validation testing prior to redevelopment on sites with a low contamination potential (Lot 36, 37 and 38 Ahoy Road, CR 1945, CR 11430, CR 24306, CR 43701 and T/L 2076). 	<ul style="list-style-type: none"> • To assess the nature and extent of contamination on sites where access has not been possible. • Provide further information on the presence of organochlorine contamination of soils. • Provide further information on the background nitrate levels entering the project area. • Confirm status of sites not considered to be of risk. 	Pre-remediation.	DEP WRC	DEP

Commitment Number	Topic	Action	Objectives	Timing (Phase)	Advice (Advisory Agency)	To the requirements of (Monitoring Agency)
6.	Execution of Remedial Works	<ul style="list-style-type: none"> • Test contaminated soil for volatile organic hydrocarbons at sites where previously detected (lot 31, 34, 1755 and 9474) • Monitor the volatile organic hydrocarbons levels at sites where found • Remove contaminated soil in accordance with the site management techniques described in the CER modified, if necessary, in light of further information. • Remove free floating petroleum product from Lots 23, and 31 Ahoy Road and Lot 51 Cockburn Road. • Dispose of contaminated material removed from sites in accordance with remediation plan and relevant DEP regulations and guidelines. 	<ul style="list-style-type: none"> • To minimise the risk to workers, the public and the environment from exposure to contaminated materials. 	Remediation.	DEP Worksafe HDWA WRC	DEP
7.	Transportation of Contaminated Material	<ul style="list-style-type: none"> • Transport materials from the site in appropriately equipped and labelled trucks in compliance with the Dangerous Goods Regulations. • cover contaminated soil during cartage. • Prepare and implement a Transport Management Plan 	<ul style="list-style-type: none"> • To minimise the risk to transport personnel, the public and the environment from the transportation of contaminated materials from the site. 	Remediation.		DME

Commitment Number	Topic	Action	Objectives	Timing (Phase)	Advice (Advisory Agency)	To the requirements of (Monitoring Agency)
8.	Disposal of Waste Materials	<ul style="list-style-type: none"> Dispose of contaminated material in accordance with the DEP Waste Acceptance Criteria for landfills in WA. The ultimate destination of all contaminated material will be selected on the basis of criteria set by the Landfill Waste Classification and Waste Definitions. 	<ul style="list-style-type: none"> To ensure all contaminated material from the site is managed or disposed in a manner which reduces environmental impact and risk to human health. 	Remediation.	DEP	DEP
9.	Public safety and environmental health	<ul style="list-style-type: none"> Prepare and implement a public safety plan 	<ul style="list-style-type: none"> To ensure remedial works and transport of contaminated material is carried out in a safe manner and that all members of the public are adequately protected from hazards. 	Pre-remediation	DEP	HDWA
10.	Occupational Health	<ul style="list-style-type: none"> Prepare and implement an Occupational Health and Safety Plan prior to remedial works commencing. 	<ul style="list-style-type: none"> To ensure remedial works and transport of contaminated material is carried out in a safe manner and that all personnel are adequately protected from hazards. 	Pre-remediation.	Worksafe	Worksafe
11.	Dust	<ul style="list-style-type: none"> Comply with DEP Guidelines for dust discharges from sites. 	<ul style="list-style-type: none"> To ensure that dust discharges during implementation of the project do not pose a risk to human health or cause loss of amenity. 	Remediation.	DEP	DEP
12.	Dust	<ul style="list-style-type: none"> Prepare and implement a Dust Management Plan for site works and transportation of contaminated material. 	<ul style="list-style-type: none"> Prevent the airborne spread of contaminated material during remedial works. 	Pre-remediation.	DEP	DEP

Commitment Number	Topic	Action	Objectives	Timing (Phase)	Advice (Advisory Agency)	To the requirements of (Monitoring Agency)
13.	Noise Emissions	<ul style="list-style-type: none"> Comply with the EP(Noise) Regulations 1997. 	<ul style="list-style-type: none"> To ensure noise generated from site remedial activities does not cause loss of amenity to nearby residents. 	Remediation.	DEP	DEP
14.	Noise Emissions	<ul style="list-style-type: none"> Prepare and implement a Noise Management Plan outlining noise mitigation measures and monitoring. 	<ul style="list-style-type: none"> To ensure noise generated from site remedial activities does not cause loss of amenity to nearby residents. 	Pre-remediation.	DEP	DEP
15.	Machinery Vibration	<ul style="list-style-type: none"> Keep machinery vibration to a minimum and comply with the Australian Standard 2670.2. monitor vibration near residential areas 	<ul style="list-style-type: none"> To ensure vibration from earthmoving machinery used in remedial works does not affect the amenity of nearby residents or damage properties. 	Remediation	DEP	DEP
16.	Public Amenity	<ul style="list-style-type: none"> Keep the closure of beach fronts for remedial works to hours outside of weekends and public holiday periods using safety barrier fencing Maintain a Complaints Register on-site. 	<ul style="list-style-type: none"> Maintain reasonable public access to the coastal areas 	Remediation.	City of Cockburn.	City of Cockburn.
17.	Public Complaints	<ul style="list-style-type: none"> Provide community consultation and communication by way of regular newsletters, articles in local papers and information sessions for the public. 	<ul style="list-style-type: none"> To ensure the public is not adversely affected by remedial works. 	Pre-remediation and remediation.	DEP	DEP
18.	Public Consultation	<ul style="list-style-type: none"> Provide community consultation and communication by way of regular newsletters, articles in local papers and information sessions for the public. 	<ul style="list-style-type: none"> To inform the community of the performance of the remedial works. 	Pre-remediation and remediation.	DEP	DEP

Commitment Number	Topic	Action	Objectives	Timing (Phase)	Advice (Advisory Agency)	To the requirements of (Monitoring Agency)
19.	Road Traffic	<ul style="list-style-type: none"> Vehicles will be roadworthy, under loaded and comply with the Road Traffic Act (1974). 	<ul style="list-style-type: none"> To ensure roads are maintained and not degraded as part of the remedial works. To ensure traffic emanating from the sites does not cause a hazard or undue inconvenience to other road users. 	Remediation.		MRWA-main roads. City of Cockburn-local roads.
20.	Validation Report-Implementation.	<ul style="list-style-type: none"> Implement a remedial and validation program to demonstrate compliance with EPA site clean-up criteria. 	<ul style="list-style-type: none"> To ensure compliance with site clean-up EPA criteria. 	Pre-remediation.	DEP	Police-vehicles DEP
21.	Flyash Management	<ul style="list-style-type: none"> Undertake leachate testing on flyash for heavy metals including barium A 1 m clean soil cover will be installed over sites with flyash deposits to provide a physical barrier to human contact. No residential landuse will occur on the Flyash deposit sites. 	<ul style="list-style-type: none"> To determine the risk of contamination to groundwater from flyash leachate To minimise the risk to future residents, workers, the public and the environment from exposure to contaminated materials. 	Remediation.	DEP HDWA	DEP
22.	Groundwater Monitoring	<ul style="list-style-type: none"> Implement a Groundwater Monitoring Plan on and downgradient of Lot 31 and 34 Ahoy Road. 	<ul style="list-style-type: none"> To prevent use of contaminated groundwater unsuitable for irrigation purposes. 	Pre-remediation.	DEP WRC	DEP
23.	Groundwater Usage	<ul style="list-style-type: none"> Restrict groundwater usage in impacted areas by placing memorials on titles. 	<ul style="list-style-type: none"> To prevent use of contaminated groundwater unsuitable for irrigation purposes. 	Post-remediation.	DOLA	DEP
24.	Sediment Management	<ul style="list-style-type: none"> Monitor and reassess sediments containing arsenic levels above the DEP Southern Metropolitan Coastal Waters Study ERL value. Arsenic testing to include the chemical form. 	<ul style="list-style-type: none"> To ensure sediment quality does not compromise the marine environment. 	Remediation.	DEP WRC	DEP

Commitment Number	Topic	Action	Objectives	Timing (Phase)	Advice (Advisory Agency)	To the requirements of (Monitoring Agency)
25.	Sediment Management	<ul style="list-style-type: none"> Implement a Sediment Monitoring Plan in those locations where contaminant levels exceed the refined sediment criteria. Prepare a contingency plan for sediment management if monitoring indicates a risk to the marine environment. 	<ul style="list-style-type: none"> To ensure sediment quality does not compromise the marine environment. To ensure sediment quality does not compromise the marine environment. 	Post-remediation.	DEP WRC	DEP
26.	Sediment Management	<ul style="list-style-type: none"> Prepare a contingency plan for sediment management if monitoring indicates a risk to the marine environment. 	<ul style="list-style-type: none"> To ensure sediment quality does not compromise the marine environment. 	Post-remediation.	DEP WRC	DEP

* Agencies:

DEP Department of Environmental Protection
 DME Department of Minerals and Energy
 DOLA Department of Land Administration
 EPA Environmental Protection Agency
 HDWA Health Department of Western Australia
 MRWA Main Roads Western Australia
 WRC Water and Rivers Commission
 Worksafe WA

Appendix 6

Summary of Submissions and Proponent's Response to Submissions

REMEDICATION OF CONTAMINATED LAND FOR RESIDENTIAL PURPOSES, SOUTH COOGEE (1004)

CONSULTATIVE ENVIRONMENTAL REVIEW

PROPONENT'S RESPONSE TO ISSUES RAISED IN PUBLIC SUBMISSIONS

This document forms the Western Australian Planning Commission principle responses to submissions to the Consultative Environmental Review (CER) for the Remediation of Contaminated Land for Residential Purposes, South Coogee.

The responses are to the issues and comments in public submissions to the CER, summarised in the Department of Environmental Protection's (DEP) correspondence to the proponent dated 11 May 1998. For ease of reference, the comments and responses are numbered in accordance with the DEP correspondence.

1. SOIL CONTAMINATION

1.1 Assessment of soil contamination:

- (a) Concern was expressed that the level of detail provided in the CER for the soil contamination assessment is:
- insufficient to properly determine whether the assessment is adequate, and
 - not comprehensive enough to fully define the nature and extent of contamination.

Response:

The information presented in the CER on each government owned site is considered sufficient to plan remediation of the sites and inform the general public of the relevant environmental issues and how they are to be resolved.

Further work was performed to address the questions raised during the public review period. The results of this work are reported in the responses to the following questions and in the attached CMPS&F report. Generally this recent work confirmed the estimates made of the nature and extent of contamination and support the conclusions made in the CER regarding the requirements for remediation.

Estimates of the volumes of contaminated material at each location were conservatively calculated given the experience gained from remediations performed elsewhere in Western Australia. This was done to ensure that the cost to remediate the government sites was not underestimated and that the proposed remediation is financially feasible.

- (b) Concern was expressed that the CER does not address how areas of 'unknown' contamination, such as possible areas of contamination beneath buildings and roads, which have not been sampled, will be addressed.

Response:

In some locations it has been impractical to determine whether contamination is present beneath roads and buildings as they are currently in use. In such instances the proponent has assumed that contamination extends into these areas and has included quantities of materials in estimates for the remediation. This is consistent with the conservative approach taken

throughout the assessment of contamination on the land. As opportunities arise the proponent will assess such areas prior to performing the remediation of the land. Remediation will then be performed in accordance with the commitments and conditions that apply to the project.

- (c) **The CER suggests that flyash located on several site lots will be left on the site. The City of Cockburn prefer that flyash be removed, or if not removed, that suitable precautions be put in place to ensure no long term problems are created.**

Response:

The proponent agrees with the approach desired by the City of Cockburn. Please refer to the attached Flyash Study.

- (d) **Additional statistically based soil sampling should be undertaken for the whole site since:**

- **illegal dumping has occurred on the site, and uncertainty relates to areas where there has been no soil sampling; and**
- **some samples taken from isolated areas were found to be unexpectedly contaminated.**

Response:

1. Initial work concentrated on land that was considered to have the potential to be contaminated by past land uses. Following this work additional sampling and testing was performed on land that was considered to have little or no potential to be contaminated. No contaminants were detected above ANZECC B during the second program (refer to attached CMPS&F report) and in accordance with ANZECC guidelines no further work is warranted. Visual inspection as part of the additional testing showed no evidence of illegal dumping with the exception of lot 35 and a small pit on lot 50. The pit on lot 50 was found to contain no contaminants above ANZECC B.
2. The only isolated or undeveloped locations found to be unexpectedly contaminated were lots 27, 27/2, 35 and 50 where there had been airborne drift of copper from lot 34. Levels of copper were found to be at most only 1.5 times ANZECC B criteria and well below risk based residential criteria applied to other residential sites in Australia. No other locations showed unexpected contamination other than some minor migration from adjoining properties known to be contaminated.

- (e) **No information has been provided in the CER as to whether there is potential for contaminants in soils left on the site to still contaminate groundwater.**

Response:

An extensive groundwater investigation programme determined that groundwater contamination in excess of irrigation guidelines was detected only on lots 31, 34 & 35 Ahoy Roads, and Part of Lot 51 Cockburn Road. The proposal described in the CER is to remove contaminated soils from these lots and the other properties to safeguard the quality of groundwaters.

The proponent commits to conducting an environment and health risk assessment process with regard to the abovementioned lots. This risk assessment process will consider the potential for soils to contaminate groundwaters. A set of cleanup criteria will be determined

by this process and the proponent commits to remediate contamination in excess of the set criteria.

(f) **Table 1, subsection 3.3 of the CER is not comprehensive enough and has omitted issues such as:**

- **Lot 23, which should have been evaluated for pesticide contamination due to the previous hide storage premises.**
- **Lot 2076, which should have been evaluated for flyash contamination as per Lot 43701. At the very least it is visually evident.**
- **Lot 2076, which should have been evaluated for any impacts from pipeline discharges and cross-beach discharges that previously took place on and around those premises.**

Response:

1. Lot 23 has been extensively tested for organochlorin (OC) and organophosphate (OP) pesticides. All soils sampled were found to be below ANZECC B (refer CER Appendix B - B2.6). Groundwater assessment performed as part of the additional work found OCs and OPs to be below laboratory detection limits.
2. The proponent describes the presence of flyash in the CER (refer Appendix B 1.10) The boundary of the flyash deposits on Lots 2076 and 43701 (adjacent to each other) were determined by a recent testing program and was surveyed. The deposits occupy an area of about 4,000 m².
3. Sediment sampling performed by BBG as part of their PCD investigations offshore of lot 2076 found no contamination above ANZECC B guidelines, however some sediments (10 out of 71 locations) exhibited arsenic levels slightly above the sediment ERL criteria. The arsenic exceedence is a management issue related to the construction of the marina rather than one of clean-up related to the government owned sites. The original source of the arsenic cannot be ascertained as the sediments have been subject to much reworking over the years and there are a number of potential sources within Cockburn Sound, especially the Kwinana industrial strip.

(g) **Table 2, clause 6.2.1 of the CER is questionable, in that:**

- **Lot 37 is directly in the path of the prevailing south westerly winds crossing lot 36. As there is no barrier on the boundary, it is highly unlikely that lot 37 has no contamination considering that lot 36 is almost totally contaminated due to airborne factors extending up to their common boundary.**
- **Lots 109, 43701 and 2076 are assumed to not have flyash as a contaminant, which is not factual and unacceptable.**

Response:

1. Recent surface testing performed on a grid basis on lot 37 showed no evidence of copper contamination arising from adjoining lot 36. The inferred extent of soil contamination shown for lot 36 has been determined from 9 locations and taken to the site boundary as a conservative measure. It is not intended to be an absolute delineation but only to provide an indication of worst case lateral extent.
2. Please refer to the attached Flyash Study.

(h) In the CER Appendix B, clause B1.10:

- it is considered an exaggeration to state that CR43701 is under vegetation cover; and
- studies by Western Power were not specific to this area and unless the nature of the soil type under these particular sites is ascertained, then it is not relevant.

Response:

1. CR 43710 consists of dunes with a vegetation cover and the exposed flyash deposits.
2. The study performed by Western Power is of relevance as it relates to an extension of the flyash deposits of 2076/43701 which occur on the South Fremantle Power Station site which was operated by Western Power.

(i) In the CER Appendix B:

- Clause B2.3, Lot 13, has not had the particular contaminants identified as requiring 1200 m³ extent of remediation nominated.
- Clause B2.5, Lot 22, has not been fully investigated for soil or groundwater contamination.
- Clause B2.11, Lot 35, has not had the actual depth or extent of contamination detailed.
- Clause B2.16, Lot 51, has not had the “environmental guidelines” used to predict the extent of remediation defined.
- Clause B2.18, Lot 109, it is questionable to assume that two surface samples are sufficient to evaluate a large area containing flyash to depth, and where PCB disposal is suspected, and then to make a blanket statement that the site does not need remediation from a human health perspective. Anecdotal advice suggests that the original flyash was covered by a soil cover and even partly blended. In this event surface sampling would not be effective.
- Clause B2.2.20, Lot 9474, has not had the road reserve adjacent to the northern boundary of Lot 9474 tested for contamination and yet there are high levels of contaminants to be remediated directly up to the boundary. Additionally the road reserve is between two sites (Lots 9474 and Pt Lot 102 West) that have known concentrations of high level contamination. The road surface has not been sealed and has been the point of access and egress for previous noxious industries. It cannot be assumed to be free from contamination as per clause B.2.24.
- Clause B3.1, Lot 2, needs further investigation to be undertaken to determine the source of the copper contamination. There are significantly high levels of copper recorded for this site and yet the substance is not known to have been commonly used in the industries insitu.
- Clause B3.4, Lot 21 and clause B3.5, Lot 23, contains no comments or results pertaining to lot 22 Ahoy Road. Clearly there is the potential for contaminated groundwater due to previous and present uses. Additionally there is a likelihood of cross contamination due to the nature of the injection bore disposal techniques emptied on adjacent Lot 23.

- **Clause B3.14, Lot 1755, needs testing undertaken to explore the possibility that the elevated mercury levels found in lot 2076 may have originated from the industry on Lot 1755. Additionally beach discharge took place in this vicinity, and it is possible that this technique was utilised in conjunction with the well as a disposal solution. This is relevant as the beach discharge method was utilised at some previous time for the adjoining property that shared the activities of Lot 1755.**
- **Clause B3.15, Lot 9474, the elevated levels of heavy metals emphasise the imperative of ensuring the removal of the flyash and other potential contaminants that have been disposed of in Lots 4370 and 2076.**
- **Clause B3.17, Reserve 43701, needs further testing as these results are inconsistent with the results of Lot 2076.**

Response:

1. Arsenic is stated as the contaminant at levels above ANZECC B environmental but below ANZECC Health guidelines.
2. Two additional soil bores have been installed to sample groundwater, and as a result no metal contamination above ANZECC B was detected. Groundwater quality is good with no detectable levels of heavy metals, pesticides or hydrocarbons.
3. Contamination is defined in the CER as superficial, the nature and extent is shown on Figure L in the CER.
4. B2.16 nominates a value of 140m³ above environmental guidelines. Further testing has confirmed this figure.
5. The initial testing was performed into visible flyash. Further testing was performed through the entire flyash profile at metre intervals to a depth of 9m. Only barium was found at levels above Dutch B guidelines and PCBs were not detected.
6. Potential does exist for some low level contamination in the unpaved road surface between lot 9474 and 102. A sample location adjacent to the road reserve on 9474 exhibited only a chromium level 10% above ANZECC B. BBG sampling on 102 showed no contamination near the road boundary. In locations such as in the unpaved road surface between lot 9474 and 102 it has been impractical to determine whether contamination is present. In such instances the proponent has assumed that contamination extends into these areas and has included quantities of materials in estimates for the remediation. As opportunities arise the proponent will assess such areas prior to performing the remediation of the land. Remediation will then be performed in accordance with the commitments and conditions that apply to the project.
7. Levels of copper are only 4% of the irrigation criteria. The source of the copper is unlikely to be associated with activities on the site although a maximum soil level of 230mg/kg was detected. The copper levels in the groundwater are within the range found at locations which are undeveloped. The copper contamination is due to a combination of low levels in the soil and normal background concentrations. Given the distance from the coast and that groundwater down gradient of the site is below aquatic guidelines, these observed levels are not considered significant.
8. Lot 21 is at the eastern part of the Port Catherine site and does not affect lot 22. The presence of hydrocarbons in the abandoned bore on lot 23 was found to be localised. The abandoned bore has not been used for substantial effluent disposal and the contamination most likely represents a one off event. No free phase or dissolved phase

hydrocarbons were detected in a recently installed monitor bore 5 m down gradient of the abandoned bore. As such remediation is not considered necessary.

9. The elevated level of mercury (below ANZECC B) found in the one monitor bore installed on the boundary of lot 2076 and 1755 is isolated and below the ANZECC B level with soil concentrations above and underneath the sample below the laboratory detection limit. Field logs show quartz sand overlying a very hard limestone at 6 m which is also the water table. The elevated mercury concentration most likely represents an accumulation due to leaching from the surface and fluctuations in the groundwater. Groundwater testing indicates no mercury concentrations above the laboratory detection limit. Soil testing on lot 1755 did show trace levels of mercury but below investigation criteria. However, the disused well on-site did not contain elevated mercury levels. Given the above the above results there appears no need to remediate the site as a result of mercury impact.
10. The connection between lot 9474 and lots 43701/2076 is not considered relevant.
11. The elevated concentration of mercury reported from MW 51A on lot 2076 was reanalysed twice and found to be below the detection limit. The earlier result most likely represents a laboratory error.

- (j) **In the CER Appendix B, Figures A to V should be amalgamated into one master plan so that the full impact of the respective areas of contamination can be appreciated. This will also assist to identify areas of potential anomalies within the “inferred extents” due to possible migration from affected areas on adjacent sites. This situation is illustrated by the relationship between Lots 36/37 and 22/23.**

Response:

This has been performed and a copy sent to the DEP assessment officer.

- (k) **The Water and Rivers Commission (WRC) has expressed concern that they had not had the opportunity to review the results and details of each of the soil contamination investigations outlined in the CER. The CER provides an outline of a series of soil contamination investigations conducted at specific Lots on the site and briefly summarises these investigations in the text in Appendix B, subsection B2.0, and in tabular form in Table 2, clause 6.2.1. The following are noted by the WRC:**

- **Appendix B, subsection B2.0 summarises the soil sampling conducted at each Lot within the subject site, but is often unspecific about the exact number of soil samples that were analysed for hydrocarbons, organochlorin (OC) and organophosphate (OP) pesticides. For the most part each subsection lists the exact number of trenches, the exact number of bores, and the total number of soil samples collected, but generally does not specify the exact number of samples that were submitted for hydrocarbons, and OC and OP pesticides analyses. Generally the text reads; “... with a number (analysed) for hydrocarbons, OC and OP pesticides.” WRC is concerned that the presence of hydrocarbon, OC and OP pesticides soil contamination has not been subject to adequate investigations.**
- **The volume of soil contamination at each Lot subject to investigation is estimated based on a specified number of sampling points. From the number of samples analysed per Lot (for contaminants other than**

hydrocarbons, OC and OP pesticides) it would be appropriate to consider each volume of soil contamination stated in the CER only as rough estimates. The Commission considers that the distribution of known soil contamination may vary considerably from the estimated volumes mainly due to variations with depth, the potential for contamination in areas (other Lots and beneath structures) not yet subject to investigation and the possible presence of other contaminants which remain to be identified at the site.

- Appendix B, subsection B2.0 and clause 6.2.1, Table 2 indicates that, some of the Lots within the subject site have not been subject to any investigation beneath the structures present on these lots. In some circumstances there could be significant soil and possible groundwater contamination present beneath these structures. This would be especially applicable at facilities formerly and currently involved in the processing of animal hides, tallow and food where indoor fluid handling, indoor sumps and other indoor plumbing features are typical. WRC is concerned that contamination beneath these buildings, particularly related to high nutrient concentrations has not been subject to adequate investigations.
- The CER states in Appendix B, clause B2.2, that “acceptance of a slight increase in the chromium environmental criteria by 20% would result in a reduction in the volume of contaminated soil...”. WRC recommends that any negotiation with regard to soil criteria be subject to health and environmental risk considerations in consultation with the Department of Environmental Protection, Health Department of Western Australia and the Commission as appropriate. Any proposal to change soil criteria should not be made solely for the benefit of reducing the volume of contaminated soil that requires remediation with no apparent consideration for any increased risk to health and the environment.

Response:

1. Pesticide and hydrocarbons were not tested at the same frequency as for heavy metals. Heavy metals have been demonstrated as the primary soil contaminant of concern. The presence of hydrocarbons was also assessed visually and pesticides were tested for in areas with a real potential for such contamination. The frequency of pesticide testing was not as per the metals as past and concurrent testing showed that the potential to exceed ANZECC B was very low. Only lot 34 has shown soil levels marginally above ANZECC B.
2. The CER nominates the contaminated soil volumes that have been conservatively estimated based on the experience gained from remediations performed elsewhere in Western Australia. A conservative approach was taken to ensure that the cost to remediate the government sites was not underestimated and that the proposed remediation was financially feasible. It is expected that some locations will have less contaminated soil that estimated while other locations will have more. However a reasonable over estimation is expected consistent with the conservative approach.
3. The potential for contamination beneath existing structures is acknowledged in the CER. Investigations have not been conducted beneath two existing buildings on lots 22 and 51 as they are still operational. However soil and groundwater investigations on these lots outside of the building showed no evidence of gross or extensive contamination. The contamination status beneath the buildings including groundwater nutrient levels would be determined at the time of decommissioning and addressed as per the approach outlined in the CER. However given the limited area of the buildings

it is highly unlikely that any contamination detected would have a significant impact on the cost and practicality of remediation.

4. The ANZECC Guidelines nominate an investigation threshold and are to be used for guidance only. Where these guidelines are exceeded consideration should be given to assessing the risk to the environment and human health taking into account site specific factors. Application of a human health based criteria could be considered at this location as a large proportion of the chromium levels are consistently low and only marginally (20%) above investigation levels (50mg/kg). The carbonate soils and limestone are alkali which will aid in immobilising the metal. Chromium levels as high as 120,000 mg/kg as Cr^{3+} and 100 mg/kg as toxic Cr^{6+} are described in the literature as acceptable for a standard residential exposure scenario (Imray and Langley, 1996). Given this it is considered that the application of a site specific clean-up level for all chromium will not compromise human health or the environment. Derwin

- (l) **Has cross-boundary contamination been investigated and how? Concern was expressed about potential cross boundary contamination between properties. Figure 1A, 1B, 1C and 1D present a mosaic of Figures A-V presented in Appendix B of the CER, which collectively delineate the inferred extent of soil contamination within the government properties. At several locations, contamination is inferred to extend to the property boundary but not into the adjacent property. This appears questionable, particularly for Lot 37 which is reported to be free from contamination but is located adjacent to Lot 36 which is almost completely contaminated due to the airborne migration from adjacent sites.**

Response:

The purpose of the soil contamination maps is to provide a conservative estimate of the potential extent of soil contamination. It is expected that at many locations this will be an over estimate. Contamination has been shown to the site boundary as a conservative measure and where testing has been performed in close vicinity to the site boundary. The final extent of contamination would be determined during remedial works and subject to validation sampling.

The superficial extent of contamination on lot 36 is conservative and is based on elevated copper levels in four out of five locations across the site. Retesting the same locations below the surface at 0.2 m to 0.3 m indicated no contamination at depth. Due to the relatively minor nature of the contamination, intensive testing was not performed which would most likely result in a reduction of the area potentially impacted by copper which is minor in terms of volume.

- (m) **Have the developments finished levels been considered in the assessment of clean-up requirements? Concern was expressed that while clean-up of the sites has the objective of providing land for the proposed development, the CER makes no commitment to clean-up soils below the new land surface which will result from the proposed earthworks for the project. In addition, there is no indication that testing has been conducted pursuant to this concern.**

Response:

The developments finished levels have been considered in the assessment of remediation requirements. However the finished levels of the development are not finalised. As a result a general approach has been outlined in the CER to deal with this issue. This is considered appropriate because the vast majority of contaminated soils above the remediation criteria are at the surface and thus the finished levels will have little bearing on the remediation.

The issue of finished levels is addressed in S 5.1.1 of the CER where it states "The proposed clean-up criteria for contamination contained within the superficial soils and in areas being excavated as part of the redevelopment will be based on the hierarchy outlined". Therefore in the limited locations where contamination occurs at depth and these areas are to be benched, ANZECC or any DEP approved health risk based values will apply at the finished level. This is especially the case for lots 31 and 34. Soils above the set criteria will be removed and soils that meet the criteria will be used to backfill the excavations created.

- (n) **Concern was expressed that insufficient work has been performed to characterise the nature, magnitude, extent and human health/environmental risks associated with contaminants that may occur in the fly ash deposits, particularly concerning Reserve 43701, where fly ash visibly extends into T/L 2076.**

Response:

Please refer to the attached Flyash Study

- (o) **The CER advises that numerous studies have been carried out on fly ash. In the absence of sufficient site specific data, what do these studies indicate about the concentrations, mobility and the consequent environmental impacts (ie. on air, soil and groundwater) from flyash disposal? Considering a review of these studies, does flyash contain contaminant concentrations that exceed the ANZECC/NHMRC guidelines, and if so, what procedures will be applied to determine remedial requirements for the flyash deposits?**

Response:

Please refer to the attached Flyash Study

- (p) **Concern was expressed that the CER does not explain the sampling and analysis quality assurance and control procedures that have been applied by the various consultants that have undertaken assessments at the government properties. In this regard, have the applied procedures complied with the Australian Standard?**

Response:

Quality assurance provisions have been applied on all investigation work performed at the government sites. This is alluded to in the CER in Section 3.2. The exact quality assurance details for each consultant is outlined in their respective assessment reports which are referred to in the CER Appendix B reference page. All quality assurance provisions are in accordance with the prevailing industry standard for performing contaminated site investigations. Should a detailed analysis be required these documents can be provided for examination.

1.2 Criteria for soil remediation:

- (a) **Concern was expressed that the level of detail provided in the CER for the soil criteria does not show which criteria have been applied in relation to each location/area of contamination. A table should be provided showing:**

- **location and area;**
- **extent of contamination;**
- **levels of contaminants;**

- remediation criteria; and
- amount of material to be excavated or remediated, including extent and depths.

Response:

Table 2 in the CER provides the location, type, severity, estimated area and volume of soil contamination. This information is illustrated on the figures in Appendix B of the CER. The maximum contaminant levels above ANZECC B are in an attachment already given to the DEP. The final volume of soil requiring remediation (material entrained in the limestone) is dependent upon the results of an environmental and health risk assessment that the proponent has committed to performing.

(b) The remediation of Lot 34 Ahoy Road is considered by Coogee Chemicals to be best dealt with by preventing any exposure pathways which could introduce contaminants to any receptor. A two path approach is required through:

- groundwater, by refraining from using site groundwater for irrigation, as proposed by the CER for 5 lots; and
- soil contamination, by covering the site with 50 to 100cm depth of local alkaline/neutral rocks and soil.

These approach paths were favoured by Coogee Chemicals in that:

- Assessment of Lot 34 Ahoy Road is mature, with many studies and significant site clean up subsequent to early studies.
- Toxicity characteristic leaching procedure tests by SKM (*SKM 1994, Contaminated Site Assessment: Lot 34, Final Report, Coogee Chemicals*) shows that the vast bulk of copper on the site is not environmentally available on the present neutral/alkaline site. This copper could be released if moved to an acidic site (*ANZECC 1992, Australian Water Quality Guidelines for Fresh and Marine Waters*), such as a landfill site. The CER states that "Conditions within landfills tend to be acidic due to the decomposition of organic wastes". This suggests an advantage in leaving the contaminated soil in the alkaline/neutral soil of the site itself (see ANZECC 1992), providing exposure pathways are blocked.
- The latest CMPS and F report on Port Catherine (*CMPS and F 1998, Port Catherine Environmental Site Assessment Draft Report, Report No. VW 1043*) proves that Lot 34 is not causing unacceptable groundwater impacts off-site.
- In agreement with the CER clause 6.3.1, Table 3, although the groundwater has contamination above criteria, no remediation is necessary; and any exposure pathways can be blocked by not using waters from this and 4 other lots for irrigation purposes.
- The proponent plans substantial siteworks, with a large quantity of soil and rock to maximise ocean views (CER subsection 1.6). A fill cover of 50 to 100cm should be used to cover the site. *ANZECC/NHMRC 1992, Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*, points out that 50cm of clean soil is unlikely to be penetrated with normal gardening activities, and that well-maintained grass can reduce exposure by at least 80%.

Response:

The approach to remediation of the Port Catherine government sites with regard to soil contamination, is to clean-up to ANZECC B guidelines. Contamination at depth within limestone will be the subject of an environmental and health risk assessment. Relatively recent testing shows that the copper contamination of the groundwater from the lot 34 has migrated some 20 m onto adjoining lot 31. Consistent with the CER it is proposed that this groundwater is unsuitable for irrigation and should be precluded from being used.

- (c) **Concern was expressed that the remediation option of excavation and disposal to landfill has not been adequately justified for the site. Removal to landfill is not the preferred option of either the:**

- **EPA under *Interim Policy for EIA No. 17 - A Site Remediation Hierarchy for Contaminated Sites*; or**
- **DEP as outlined in Position No. 13 in the *Contaminated Sites Public Position Paper (1997)*.**

As a significant amount of soil is to be disposed of, why is it not feasible to reduce this amount by treating some areas, either in-situ or ex-situ?

Response:

In Western Australia the disposal of soils contaminated with heavy metals to landfill is common practice because it is a reliable and offers a long term secure approach to waste management. At Port Catherine the majority of the soil contamination consists of heavy metal contamination and this is generally difficult to remediate cost effectively. The situation at the Port Catherine site is further complicated by the total volume of contaminated soil being made up of soil with different types and combinations of heavy metal and hydrocarbon contamination. Thus it is unlikely that any one treatment will be able to decontaminate all the contaminated soils. The cost to remediate the sites would be substantial if a variety of different treatment technologies were to be used on relatively low volumes of soil. It is envisaged that contractors commissioned to remediate the site will have the option to treat the soil. Pretreatment to reduce leachate potential maybe required on some of the heavy metal contamination prior to landfill disposal.

- (d) **Concern was expressed that the proponent does not say what they will do with the areas that have been excavated of contaminated soil. Will they be refilled with clean sand?**

Response:

Generally contamination is on the surface and will not involve deep excavation. Consequently there will be no need to backfill many sites after they have been remediated. Where this is considered necessary for safety reasons, excavations will be reinstated with suitable fill validated as clean which maybe sourced either from on-site or off-site.

1.3 Health risk assessment for soil contamination at depth:

- (a) **The health risk assessment model criteria for soil contamination at depth should:**
- **be undertaken up front, with the detailed methodology specified and management procedures outlined;**
 - **provide opportunity for interested parties, such as the City of Cockburn, to input to the health risk assessment and management strategies; and**

- **allow for some adjustment of the exposure setting of ‘Standard’ residential, as control of poultry and growing of vegetables is difficult to control by local government on residential properties.**

Response:

The proponent has committed to preparing an environmental and health risk assessment on those sites where contamination extends at depth and would be impractical to excavate prior to commencing the remediation of the relevant sites. The proponent commits to preparing the risk assessment in consultation with and to the satisfaction of the DEP, Department of Health, and if necessary the City of Cockburn.

The proponent proposes to perform the risk assessment once the finished levels of the future development are determined. Ideally the risk assessment should be performed once the development plan for the site has been established so the proposed finished levels for the site could be known. If finished levels were sufficiently low there may be no need for risk assessment as the material would be removed as part of the excavation program.

- (b) **Concern was expressed that the level of detail provided in the CER for the health risk assessment model criteria for soil contamination at depth does not show which criteria has been applied in relation to each location/area of contamination. A table should be provided showing:**

- **location and area;**
- **extent of contamination;**
- **levels of contaminants; and**
- **remediation criteria.**

Response:

The environmental and health risk assessment approach will be applied to lots 31 (part of adjoining lot 51), 34 and 35 which have contamination at depth up to 15 m. The location, depth and extent of contamination are shown on the figures in Appendix B. The remediation criteria will be determined by the health risk assessment process to the satisfaction of the DEP and HDWA.

- (c) **Concern was expressed that there was no mention of a time frame for the process of health risk assessment modelling concerning not excavating contamination at depth.**

Response:

The proponent has committed to performing the risk assessment. This work will be performed prior to performing the remediation of lots 31 (part of adjoining lot 51) 34 and 35 which have contamination at depth. It is envisaged that this work will be commenced immediately after the finished levels for the development are known.

- (d) **Concern was expressed that the proposed site remediation criteria hierarchy outlined in the clause 5.1.1 of the CER needs to be altered to read:**

1. **Soil contaminant concentrations above ANZECC (1992) *Environmental Investigation B, Soil Quality Guidelines*;**
2. **Soil contaminant concentrations above ANZECC (1992) *Proposed Health Investigation Level Guidelines*;**

3. Soil contaminant concentrations above *Dutch (1983), B level Guidelines for Soil Remediation (1983) for the Assessment of Soil Contamination;*

as the *Environmental Investigation B Soil Quality Guidelines* takes into consideration health and the environment, and is therefore more sensitive.

Response:

The health levels were first nominated as they represent acceptable contaminant concentrations from a public health perspective as residential is the nominated end land use. The proposed hierarchy then reverts to ANZECC B for those compounds not nominated in the proposed Health Investigation Guidelines as a default clean-up criteria. It is important to note that *ANZECC (1992) Environmental Investigation B, Soil Quality Guidelines* are as the title suggest, investigation criteria and their use is for assessment purposes and should not necessarily be viewed as an absolute clean-up level.

The proponent acknowledges that the Contaminated Sites Section of the DEP requests that ANZECC B be used rather than the health guidelines where no site specific risk assessment has been performed. Therefore the proponent will not apply the health investigation levels in the proposed remediation hierarchy. However where appropriate, an environment and health risk assessment maybe applied in locations other than what is currently proposed (ie: Lots 31, 34 and 35 Ahoy Road). This would be performed to the satisfaction of the DEP and HDWA and would be considered only where contaminant levels do not pose a threat to the environment.

- (e) **Concern was expressed by the Water and Rivers Commission (WRC) that it remains possible that some indirect human contact with hydrocarbon and pesticide vapours could result from leaving contaminants at depth in situ. WRC recommends that health risk assessment modelling be conducted where any hydrocarbon and/or pesticide contamination is to be left in situ and all health risk assessment modelling, including all applicable input variables, outputs and results be subject to evaluation by the Department of Environmental Protection and Health Department of Western Australia.**

From a soil and groundwater perspective, the WRC would require the proponent to conduct an evaluation of the risks to the subsurface and marine environments by fate and transport modelling for specific contaminants, in the event contamination is proposed to be left in situ.

Response:

The potential for vapours from hydrocarbons and pesticides resulting from the remaining contamination at depth is considered to be very low due to the following reasons:

- there will be no residual pesticide contamination following remediation or at depth (subject to risk assessment) as existing contamination is restricted to the surface which will be removed as part of the clean-up program for lot 34;
- hydrocarbon contamination will remain at depth on lot 31 and adjoining lot 51, the nature of this contamination is that it is almost entirely heavier fraction hydrocarbons with low volatility.

Therefore due to the absence of volatile compounds, it is considered that there is no need to undertake health risk modelling with regard to vapour emissions from pesticides or hydrocarbons. The proponent has committed to remediating hydrocarbon contamination floating on the groundwater surface that would have a far greater potential for generating vapour emissions compared to soil contamination..

The proponent has committed to an environment and health risk assessment for residual soils and fate and transport modelling for residual contaminated groundwater at lots 31, 34 and 35 Ahoy Road, and Lot 51 Cockburn Road.

Fate and transport modelling will show whether any residual contamination will cause degradation of the water quality of the ocean. Factors such as dispersion, sorption processes (ie; natural attenuation) and mixing within the groundwater will be considered.

- (f) **Concern was expressed that the CER does not categorically state that the proponent will commit to either clean-up to generic guidelines or site specific criteria derived by health risk assessment. Specifically, such a statement is missing from the list of commitments and the generic criteria referred to (that is ANZECC/NHMRC and Dutch B) are not actually presented in the CER.**

Response:

The proponent commits to clean-up to generic guidelines (ie; the ANZECC guidelines) or site specific criteria derived by an environment and health risk assessment. In addition to this commitment, the CER describes throughout an approach to remediation and commits (No. 6 in Commitments) to remediation in conformance with site clean-up criteria endorsed by the DEP. The proposed criteria are nominated in Section 5.1.1, with the exception that the ANZECC health investigation levels are now excluded in the hierarchy. The relevant criteria are referenced in the CER. It is anticipated that any approval for the project will be conditional on the work being performed in the manner described in the CER.

- (g) **Concern was expressed that the CER does not indicate that areas of deep soil contamination that may be contributing to ongoing groundwater contamination will be remedied. While the CER indicates that health risk assessment will be conducted in these circumstances, there is no commitment that clean-up will occur if health risk assessment indicates an unacceptable human health risk.**

Response:

The proponent commits to the remediation of soil that is shown to pose an unacceptable risk by a process of an environmental and health risk assessment.

- (h) **Concern was expressed that health risk assessment derived criteria for "deep contamination" may inadequately protect the underlying groundwater and water quality within the proposed marina.**

Response:

The proposed approach is to remove the most significantly contaminated soils and waste at the surface that have caused groundwater contamination. Investigations have determined that deep soil contamination, close to the watertable is restricted to lots 31 and 34 Ahoy Road, and lot 51 Cockburn Road. It is considered that residual soil contamination that remains after remediation will have relatively little impact on overall groundwater quality across the site. Groundwater usage will be precluded in areas unsuitable for irrigation purposes.

The proponent has committed to an environment and health risk assessment for residual soils, and fate and transport modelling for residual contaminated groundwater beneath lots 31, 34 and 35, and lot 51 Cockburn Road. Fate and transport modelling will show whether any residual contamination will cause degradation of the water quality of the ocean. Factors such as dispersion, sorption processes (ie; natural attenuation) and mixing within the groundwater will be considered.

Should groundwater fate and transport modelling predict that residual soil contamination proposed to be retained on these lots does adversely effect the water quality of the ocean, remediation and/or long term management of the source (deep soil contamination) will be undertaken.

It is considered that the design of the proposed marina must take into account the existing groundwater quality and that this issue is most appropriately considered in the assessment of the proposal to develop rather than remediate the land.

- (i) **Concern was expressed that in the CER clause 5.2.3 assessment approach, the term “prohibitively expensive” was not adequately defined, requiring further definition, and that details of the proposed risk assessment methodology should be provided and agreed to by DEP.**

Response:

“Prohibitively expensive or difficult to treat or remove” (Section 5.2.3) refers to that contamination absorbed and entrained within the cracks and fissures of the underlying limestone rock. To remove this rock may involve substantial earthworks including blasting with the potential to spread such contamination (ie; airborne dust emissions). Should this contamination not represent a risk to the environment, the material could be potentially retained. The proponent has committed to the preparation of an environment and health risk assessment to the satisfaction of the DEP and the Department of Health. This will determine the acceptability of retaining the contaminated material.

To remove the copper contamination from lot 34 would involve construction of up to a 15 m deep excavation through mostly cemented limestone rock. To facilitate this depth over a basal area of 150 m² would require an excavated surface of 800m². As the rock is karstic there are potential problems associated with collapse. Earthmoving rates could be expected to be between 2 and 4 times the cost for a similar scenario in sand.

Should groundwater fate and transport modelling show the need for remedial works and that removing the source is impractical, alternative management options will be considered.

- (j) **Concern was expressed that the CER presented no information on contamination in the limestone and/or caverns which would be a threat to human health and/or the environment. This aspect needs to be clarified.**

Response:

The CER describes the extent of contamination on lots where contamination extends into the limestone, including caverns (Appendix B). The proponent has committed to preparing an environment and health risk assessment on those sites where contamination extends at depth. This risk assessment would be prepared in consultation with and to the satisfaction of the DEP, Department of Health, and if necessary the City of Cockburn. The proponent commits to remediating (including management) deep contamination, if based on the outcome of the environmental and health risk assessment, is found to unacceptable.

- (k) **Concern was expressed that the CER presented no information on the characteristics, quantities and locations of contaminants to be left in place. If these ‘left in place’ contaminants were below ANZECC criteria, then treatment and monitoring would not be required.**

Response:

The environmental and health risk assessment approach to contamination at depth will be applied to lots 31 (part of adjoining lot 51), 34 and 35 which have contamination at depth up to 15 m. The location, depth and extent of contamination is shown on the figures in

Appendix B of the CER and in updated maps based on additional investigations performed subsequent to the release of the CER (these have been provided to the DEP). The remediation criteria for the risk assessment will be determined to the satisfaction of the DEP.

The finished level for the development are not fully known at this time and this has resulted in a general approach being outlined in the CER to deal with this issue. This is considered appropriate because the vast majority of the total volume of contamination above the remediation criteria (80%) is at the surface and finished levels will have little or no bearing on the remediation of most of the sites. The proponent commits to remediating (including management) deep contamination, if based on the outcome of the risk assessment, is found to unacceptable.

- (1) **Concern was expressed that the CER did not address the issue of risk assessment with respect to the “local environment”. However, this could be an extremely complex issue (particularly with respect to marine life).**

Response:

The proposal is to remediate the majority of government properties to conservative ANZECC B investigation guidelines. Risk based guidelines, based on local conditions, are to be derived where contamination extends to substantial depth.

2. GROUNDWATER QUALITY

2.1 Groundwater contamination:

- (a) **Concern was expressed that the level of detail provided in the CER for the groundwater contamination:**
- **makes overall assessment of the nature and extent of contamination difficult;**
 - **identifies groundwater contamination present on several locations, but then dismisses the need for remediation without any supporting explanation, which allows proper judgement as to whether the approach proposed is adequate.**

Response:

Groundwater monitoring has been undertaken in those areas with a potential for significant contamination based on site features and previous investigation results. Where significant groundwater contamination has been observed which precludes its use for irrigation, the extent of impact has been determined with additional wells. Extensive monitoring has been performed along the coast and offshore at the ocean/groundwater interface to assess the status of the groundwater entering the ocean.

The CER outlines the approach to groundwater remediation in Section 6.3.2 which is summarised on Table 3. The proponent has committed to remediate groundwater contamination where this is considered practical, particularly it has committed to removing hydrocarbons that are floating on the groundwater surface that have originated from Lots 23 (disposed down a bore) and 31 Ahoy Road. The proponent does not propose to remediate dissolved heavy metal and hydrocarbon contamination from lots 31 and 34 as this is considered to be impractical. This is because pumping the contaminated groundwater would be unsuccessful given that the coastal limestone formation has solution cavities that would make the selective removal of contaminated groundwater very difficult to achieve. Even if this could be achieved the cost to treat large volumes of groundwater contaminated with relatively low levels of contaminants to levels suitable for irrigation would be cost prohibitive.

The costs to recover and treat large volumes of groundwater would be in the order of hundred of thousands to millions of dollars, the efficacy of which is questionable.

The proponent will however commit to preparing a contingency plan should the proposed groundwater fate and transport modelling show that significant environmental impacts are likely to occur. This plan will describe any and all practical measures to ameliorate such impacts. It will consider all practical management techniques and groundwater extraction, treatment and containment options.

Please refer to hydrogeology appraisal for a more detailed evaluation of groundwater remediation options.

- (b) Concern was expressed that no detail of the modelling undertaken to determine the impact of groundwater contaminants on the future marina is provided in the CER. Details of the health risk assessments proposed to be undertaken are also not provided.**

Response:

The construction of a marina is not part of the proposal dealt with under the CER. The proponent considers that the environmental assessment for the marina development should take into account the groundwater contamination after the proposed remediation.

The potential impact of contaminated groundwaters on the marina water quality is dependant on the configuration of the marina which has not yet been determined. Further to this the configuration of the marina is outside the control of the proponent for the remediation of government owned properties.

- (c) The CER does not reflect adequate groundwater investigations, in that there:**
- **is insufficient information to restrict the installation of irrigation bores on lots 23, 31, 34 and 2076 only;**
 - **are limited numbers of bores on some lots, which do not enable adequate determination of water quality being suitable for irrigation over the whole lot; and**
 - **is insufficient information on how restrictions on irrigation are to be achieved.**

Response:

1. Groundwater testing has been performed on all the lots with potential for contamination. Testing further to that described in the CER has been performed on lots 22 and 23 and no contamination in excess of irrigation criteria was found. Lot 23 does however contain some minor levels of heavy fraction hydrocarbons above the Dutch Intervention level which would make it unsuitable for drinking purposes but not necessarily irrigation. Thus review of all results obtained on the government owned sites show that contamination in excess of irrigation criteria exists only in association with lots 31, 34 and partially on lot 35 at the boundary with lot 34. An elevated mercury level first found on lot 2076 was retested twice and was not detected.
2. Groundwater monitoring was undertaken in areas considered to exhibit a potential for contamination based on their previous land use. Where significant contamination was detected by initial investigations, more intensive groundwater testing was performed to delineate the extent of this contamination.

3. The Water and Rivers Commission has the power to declare the contaminated areas as restricted use areas for groundwater extraction. People wishing to install a bore within the restricted area would need to apply for a licence and the acceptability of any bore would be assessed by the commission prior to the licence being issued. The need to apply for the licence would be placed on titles to make purchasers aware of the issue. The use of licenses would minimise the potential for human contact but not necessarily eliminate it. Inspections could be carried out from time to time to ensure there are no unlicensed bores operating in the affected areas.

- (d) It is likely that contaminated groundwater will move from the existing contaminated lots into adjacent lots over time. Will this be monitored by the proponent and how?**

Response:

The proponent has committed to remediating groundwater by recovering the oil associated with lots 23 and 31. Part of the remediation program will involve monitoring the success of the remediation as outlined in Section 5.1.2 of the CER. It is proposed that existing groundwater monitoring bores in the pathway of dissolved phase hydrocarbon and heavy metal contamination from lots 31, 34, 35 and part of lot 51 will be monitored for these parameters on an annual basis.

- (e) If groundwater contamination exceeds the irrigation criteria, how often will monitoring be undertaken by the proponent?**

Response:

The proponent commits to monitoring as outlined in Section 5.1.2 of the CER. The frequency of testing will be annually.

- (f) Concern was expressed that in the CER there was no mention of the groundwater having been tested for pesticides, and whether there is significant contamination?**

Response:

Groundwater was tested for pesticides in areas likely and known to have potential for such contamination. This is described in Appendix B of the CER. Contamination above drinking water guidelines was not detected at any site. Five sites did contain OC or OP pesticide levels above the aquatic protection criteria. The maximum observed exceedence was 14 times on lot 34. For those sites along the coastal foreshore, pesticide levels were generally double the criteria. Applying a conservative dilution factor of 20 with the ocean ensures concentrations would be at most 70%, and generally 10% of the aquatic protection criteria.

- (g) Concern was expressed that in the CER there was no explanation of what nutrient levels are contained in sediments and groundwater under the former animal processing plants (eg abattoirs and associated animal holding yards).**

Response:

Nutrient testing has been performed in a number of monitor bores on sites used for animal processing. Results indicate no areas of elevated nutrients compared to background concentrations. Background levels were determined through literature review and testing of groundwater upgradient of the site. Davidson (1995) concluded natural nitrate levels to be between 1 mg/l and 7 mg/l. Concentrations as high as 60 mg/l could be expected in areas with intense fertilisation such as market gardens. The generalisation was made that levels in excess of 60 mg/l are attributable to industrial/liquid waste activities. Nitrate concentrations

up to 80 mg/l have previously been recorded in groundwater within the Coogee area (Appleyard, 1990). The highest reported nitrate concentration for the site is 8.5 mg/l on lot 23 used for the storage of hides. Most sites exhibit nitrate levels between 2 mg/l and 3 mg/l.

The current groundwater flow into the ocean is estimated at 3,080 m³/day/km of coast. Assuming an average total nitrogen level of 5 mg/l, the flux of nitrogen into the ocean is estimated at 5,600 kg/km.

- (h) **In the fourth paragraph of subsection 3.5 of the CER, there was a reference to an annual nutrient loading into Owen Anchorage from groundwater of approximately 10 tonnes per year for nitrogen and less than 0.2 tonnes per year for phosphorus. Concern was expressed that the 10 tonnes per year for nitrogen was only a projection, and that the CER has not produced any evidence to test whether this projection was realised.**

Response:

The figure quoted is a projected value obtained in the Southern Metropolitan Coastal Waters Study performed by the DEP. The groundwater nutrient loadings are provided in the CER as background information only. No conclusions or calculations are presented in the CER based these figures.

- (i) **What will be the protocol for forwarding fate and transport computer modelling to the Department of Environmental Protection?**

Response:

The proponent has committed to performing the fate and transport modelling prior to remediation of the affected lots. As such the proposed modelling will be discussed with the DEP. If the proposed program is to the DEP's satisfaction the work will be performed and the results forwarded to the DEP. If the DEP are satisfied with the approach taken the proponent will seek to have the condition cleared.

- (j) **In the CER clause 6.3.1, Table 3, there is no supporting data to identify the severity of groundwater contamination at each lot. Every single lot, including those where there was flyash disposal, exceeded the aquatic protection criteria. The flyash locations clearly indicate the presence of elevated levels of heavy metal contamination. Yet, only three of the sites are nominated for remediation. This implies that the source of the contamination is not to be remediated, which is unacceptable. There is also no adequate commitment to remediation.**

Response:

The groundwater underlying the flyash has been monitored at three locations. In all locations, heavy metals with the exception of barium and antimony were below the laboratory detection limit. There are no aquatic protection criteria for barium which varied between 0% and 50% of the drinking water guidelines. Antimony levels were 2% of the aquatic protection criteria.

The aquatic protection guidelines are designed to apply to water within the receiving water body rather than water that discharges to a receiving water body. Factors such as dilution within the aquifer, dilution at the point of discharge of the aquifer to the ocean and dispersion in Owen Anchorage need to be taken into account when considering conformance to the aquatic protection criteria.

The application of dissolved contaminant concentrations is more conservative than total contaminant concentrations with regard to conformance to the aquatic protection criteria. Dilution assumptions are predicated on dissolved concentrations and not suspended solids. Contaminants present as suspended solids would not be as bioavailable as that which is dissolved and would settle out in the aquifer and in the ocean water column.

(k) **The Water and Rivers Commission (WRC) has expressed concern that they had not had the opportunity to review the results and details of each of the groundwater contamination investigations outlined in the CER. The CER provides an outline of a series of groundwater contamination investigations conducted throughout the site and briefly summarises these investigations in Appendix B, subsection 3.0 and in Table 3. The following are noted in relation to the CER by the WRC:**

- **Throughout the CER it has been noted that nutrients are a regional issue related to upgradient market garden activities and are, therefore, not a site-specific consideration. The WRC considers that, of the previous land uses listed in Table 1, subsection 3.3, there are numerous potential sources of nutrients throughout the site. These include all areas where animal hides, food products, and other animal product processing has occurred and where dumping of associated wastes and discharges of wash waters from these industries has occurred. The WRC requires that nutrient levels in groundwater associated with each of these industries be subject to more detailed investigations and, where applicable, consider on-site nutrient contamination of groundwater as a relevant issue.**
- **Appendix B, subsection B3.0 provides a summary of the various areas that are subject to groundwater investigations and discusses groundwater quality for the purposes of irrigation. The WRC supports the approach to conduct remediation or enforce groundwater use restrictions where groundwater quality precludes the use of groundwater for irrigation or any other beneficial uses.**
- **The WRC notes a comment in Appendix B, subsection 3.9 where it is stated that "...the concentrations of and OP's do not compromise its use for irrigation." Although the applicable irrigation guidelines do not recommend any guidelines for pesticides *per se* there may be some adverse health and/or environmental effects associated with irrigation with pesticide contaminated groundwater. It is recommended that a health risk assessment be conducted to determine any detrimental effects. Any such health risk assessment should be subject to review by the Health Department. Where guideline values for irrigation water quality have not been defined or set for particular contaminants, the WRC recommends a health risk assessment be conducted for those contaminants and possible synergistic effects considered prior to allowing any irrigation with groundwater to occur.**
- **Where contamination levels are in excess of irrigation water quality guidelines the WRC supports the approach to conduct contaminant fate and transport modelling of the migration potential of the contaminant. This modelling, including input data, outputs and results would be subject to review by the WRC. As a general rule, any groundwater contamination in excess of the irrigation quality guidelines at the site, should be subject to adequate investigation to determine the extent of the contamination, groundwater flow direction within the area subject**

to the contamination, and monitoring to determine any changes over time and to validate results of any fate and transport modelling.

- **Where groundwater contamination is in excess of the solubility limit of any contaminants, and/or where separate phase product is observed the WRC supports the approach to a more thorough investigation of the extent of the contamination and conducting groundwater remediation without unnecessary delay. This would be desirable to prevent further migration of contaminants and an ongoing source of groundwater contamination in the area.**
- **The WRC is concerned that groundwater abstraction at the site for irrigation purposes may have effects on the groundwater flow dynamics at the site such that areas of contaminated groundwater could be affected and possibly draw contamination into the irrigation bores over time. The WRC recommends that the capture zone of each irrigation bore be modelled and each irrigation bore be sampled prior to commissioning and be subject to regular monitoring as determined by the WRC.**

Response:

1. Nutrient testing has been performed in a number of monitor bores on sites used for animal processing. Results indicate no elevated nutrient levels compared to background concentrations. This is reported in detail in separate documentation accompanying these responses.
 2. Noted
 3. No pesticides were detected at concentrations above drinking water criteria. The highest concentrations were two orders of magnitude below this criteria and on this basis are suitable for direct human ingestion. It is on this basis that the risks associated with using the groundwater for irrigation are considered negligible and thus risk assessment is not considered applicable.
 4. Noted
 5. The proponent has now delineated the extent of separate phase product on lot 31 and has committed to remove this product. The product has migrated no more than 10 m down gradient of the impacted bores. However it is recognised that this remediation needs to be performed as soon as possible.
 6. Contaminated groundwater in excess of irrigation criteria has been identified only on lots 31, 34, part of lot 51 and on the boundary of lot 35. Based on this information, restrictions on groundwater are to be applied. The extent of any exclusion area for the installation of irrigation bores will be established on the advice and to the satisfaction of the Water and Rivers Commission. There maybe some use groundwater suitable for irrigation for filling of swimming pools. This practice should be discouraged, however the groundwater outside of that requiring restriction is suitable from a chemical contaminant perspective. The presence of bacteria may preclude its use if not suitably disinfected.
- (I) **There is very little information presented on contaminant plumes in the CER, although general information on groundwater investigations on each site is presented in Appendix B. In many cases where contamination has been detected it appears that its extent has not been investigated. Since there is no figure presented in the CER that shows the locations of detected**

contamination, it is difficult to readily ascertain the types and extents of contamination. The information presented in the CER on groundwater contamination is not complete and does not appear to provide a reasonable level of confidence that the types and extents of groundwater contamination have been identified.

Response:

The CER presents the results of investigations performed by others in summary form and makes reference to those other studies. In addition to this work further recent investigations have delineated the extent of groundwater contaminant plumes with levels in excess of irrigation criteria. Specifically the proponent has now delineated the extent of separate phase product on lot 31 and the extent of copper contamination from lot 34 (part lot 35). The proponent has committed to remove the floating hydrocarbon product. The product has migrated no more than 10 m down gradient of the impacted bores. However it is recognised that this remediation needs to be performed as soon as possible.

There exists groundwater contamination above aquatic protection criteria, however there are no discernible plumes with the exception of lots 31 and 34. It should be noted that contaminant concentrations are only marginally above the aquatic criteria.

2.2 Criteria for groundwater remediation:

(a) Concern was expressed that the level of detail provided in the CER for the groundwater criteria does not show which criteria have been applied in relation to each location/area of groundwater contamination. The CER Table 3, clause 3.3, does not allow determination of how the decisions on the need for remediation have been derived. A table should be provided showing:

- **location and area;**
- **extent of contamination;**
- **levels of contaminants;**
- **remediation criteria; and**
- **amount of groundwater to be removed or remediated.**

Response:

Table 3 in the CER Section 6.3 provides a qualitative description of the groundwater contamination status at the respective sites. The table provided details the contaminant and status regarding exceedance above relevant criteria.

A map and table is provided which shows the contaminant plumes associated with exceedence of irrigation criteria and levels of exceedence with regard to each particular site.

(b) The City of Cockburn prefer that attempts be made to treat or otherwise manage groundwater contamination, rather than relying on the 'disperse and monitor' approach taken in the CER. This position is based on:

- **the possible long term impacts of groundwater on marine water quality;**
- **the lack of realistic approaches to managing marine water quality problems should adverse impacts occur; and**
- **concerns about the long term viability of controls on groundwater abstraction for irrigation, as there will be a strong desire by land users for private bores.**

Response:

The proponent has committed to remediate groundwater contamination where this is considered practical, particularly it has committed to removing hydrocarbons that are floating on the groundwater surface that have originated from Lots 23 and 31.

At this stage it is considered that the dissolved copper and hydrocarbon contamination associated with lots 31 and 34 cannot be practically treated. This is because pumping the contaminated groundwater would be unsuccessful given that the coastal limestone formation has solution cavities that would make the selective removal of contaminated groundwater very difficult to achieve. Even if this could be achieved the cost to treat large volumes of groundwater contaminated with relatively low levels of contaminants to suitable levels would be cost prohibitive.

The free phase contamination initially detected on lot 23 represented a one off disposal event. Groundwater monitoring 5 m downgradient showed no hydrocarbon contamination above the laboratory detection limit.

The monitor bores have been constructed in accordance with WRC requirements, construction details for each bore are shown in the logs attached as appendices in the relevant site assessment reports.

- (c) **The CER summaries of Table 3 and clause 6.3.1 that recommend no remediation for groundwater, and no use of groundwater for irrigation at Lot 34 Ahoy Road, are endorsed by Coogee Chemicals. A health risk assessment is considered unnecessary by Coogee Chemicals, as sufficient data is available; but a health risk assessment would provide additional reassurance for the public.**

Response:

Noted, the proponent has also committed to undertaking a groundwater fate and transport study of the underlying groundwater.

- (d) **The determination of remediation dependant on sampling undertaken several years ago is not considered appropriate. Lot 21 for example was last sampled in 1994. Sampling as long as four years ago, cannot determine whether remediation is, or is not, necessary now.**

Response:

Lot 21 is a vacant, undeveloped property which is up gradient of the Port Catherine site and there is no evidence to suggest that the site has the potential to be contaminated. No land use activity has been identified as occurring in the last four years that would have resulted in contamination of the groundwater at that location. The 1994 testing indicated no significant contamination and was considered to be representative of "background levels".

- (e) **The CER has no discussion of the preferred method of treatment for contaminated groundwater at each particular lot (23, 31, 34 & 2076) and when treatment will occur.**

Response:

Recent testing has confirmed that lots 23 and 2076 are not contaminated above irrigation criteria. Lots 31 and 34 exhibit significant contamination. The approach to remediation is outlined in Section 6.3.2 and lot 34, Section 5.3 of the CER.

The proponent has committed to remediate groundwater contamination where this is considered practical, particularly it has committed to removing hydrocarbons that are floating on the groundwater surface that have originated from Lots 23 and 31. The proponent does not propose to remediate dissolved heavy metal and hydrocarbon contamination from lots 31 and 34 as this is considered to be impractical. This is because pumping the contaminated groundwater would be unsuccessful given that the coastal limestone formation has solution cavities that would make the selective removal of contaminated groundwater very difficult to achieve. Even if this could be achieved the cost to treat large volumes of groundwater contaminated with relatively low levels of contaminants to suitable levels would be cost prohibitive.

- (f) **The CER should have assembled sufficient information on contaminant groundwater fluxes and its environmental implications for near shore marine waters, rather than the proponent simply committing themselves to a contingency plan.**

Response:

Information presented in the CER and supplementary reports referenced in the CER provide a description of the nature and extent of groundwater contamination. Groundwater quality along the coastline has been extensively evaluated both onshore and offshore and the results are presented in the CER.

Information in relation to the marina is provided in the CER as background and the marina proposal is not part of the proposal which is the subject of the CER. Preliminary modelling performed by consultants for the marina proposal, BBG indicate that the predicted flushing rate in the marina will result in acceptable water quality in terms of protection of aquatic life (Section 6.5.2 of the CER).

The proponent intends to remediate the site as outlined in the CER even if no development proceeds. The developer PCD intends to implement a marina water quality monitoring program (S 6.5.2 of the CER). However the proponent of the proposal to remediate the government properties commits to validating the dilution assumptions made as part of the groundwater fate and transport modelling. This would involve monitoring of the marine waters.

- (g) **The CER in subsection 5.3 should under the threshold criteria for assessing the need for groundwater remediation related to government sites, include the risk of not significantly increasing the stimulating of algal blooms within the marina.**

Response:

Testing has shown that groundwaters related to government owned properties do not have elevated nutrient levels above background concentrations. Consequently no potential to stimulate algal blooms is expected from groundwater contaminants that have originated from government owned sites. Extensive groundwater monitoring both across the sites and along the coastline found no groundwater contaminant plumes or slugs apart from lots 31 (including part of lot 51) and 34 (including part of lot 35).

- (h) **The CER in clause 5.3.1 needs to consider:**

- **in the case of nutrients, the load as well as the concentration in groundwater;**
- **chemical, physical or biological transformations, when the contaminants in the groundwater meet the seawater. It is too simplistic to just consider the fate of contaminant fluxes in**

discharged groundwater in terms of dilutions. Is there potential for accumulation of particulates, algae, etc.

Response:

1. Testing has shown that significant nutrients concentrations in groundwaters have not resulted from past activities on government owned properties. Given this there would be no potential for the accumulation of algae as a consequence of these properties.
2. The proponent has proposed all the actions that it considers possible to safeguard the health of the public and the environment. It proposes to remove the sources of contamination on the government owned sites and remediate groundwater contamination that can practically be treated. The assessment of the chemical, physical or biological transformations, when contaminants in the groundwater meet the seawater is considered to be of limited benefit.

- (i) Concern was expressed that there was no evaluation provided of nutrient (nitrogen) concentrations and loads in the CER. Will the residential development make it more difficult for the proponent to manage contaminants in groundwater, which are currently upstream of the proposal (eg nutrients in groundwater from market gardens' etc)?**

Response:

The proposal that is the subject of assessment is the remediation of contaminated sites owned by government in the Port Catherine area. The impacts of residential development on the management of regional nutrient levels is considered to be beyond the scope of the assessment.

- (j) In reference to clause 5.1.2 of the CER in establishing clean-up criteria for groundwater, this:**

- **should not only be focused on the point of abstraction, but also on the remedial requirements at the original source of the contamination; and**
- **restriction of groundwater use is not consistent with the intent of the project agreement between the Western Australian Planning Commission (WAPC) and Port Catherine Developments Pty Ltd relating to the WAPC responsibility to deliver remediated unconstrained land.**

Response:

1. The criteria applied to groundwaters relate to its beneficial use. In this case the relevant use is for irrigation purposes and the criteria for this use apply at the point of abstraction.
2. The proponent considers that the project agreement between the Western Australian Planning Commission (WAPC) and Port Catherine Developments Pty Ltd to be of no relevance to the assessment of potential impacts posed by the remediation project.

- (k) In relation to clause 6.3.2 of the CER, concern was expressed about:**

- **the uncertainty of the statutory powers of the Water and Rivers Commission in licensing residential bores;**
- **there being no nomination of the party responsible for applying for a bore licence; and**

- **caveats on the usage of groundwater being inconsistent with the project agreement.**

Response:

1. The Water and Rivers Commission has the statutory power to declare areas where applications for licences need to be made to install bore and have the ability to reject such applications.
2. Bores in designated areas need to be licensed and applications need to be made to the Water and Rivers Commission prior to the issuing of such licences.
3. The proponent considers that the project agreement between the Western Australian Planning Commission (WAPC) and Port Catherine Developments Pty Ltd to be of no relevance to the assessment of potential impacts posed by the remediation project. To protect human health, the proponent considers it is reasonable to place caveats on those lots where groundwater is precluded for irrigation use. The entire Port Catherine development would be a licensed area.

- (l) **Concern was expressed that the proponent does not say what they will do with the contaminated groundwater. The contaminated groundwater should be treated to purify it before it is discharged.**

Response:

The proponent has committed to remediate groundwater contamination where this is considered practical, particularly it has committed to removing hydrocarbons that are floating on the groundwater surface that have originated from Lot 23 and 31.

The exact methodology to be employed will be dependant on the nature of the contaminants and the relative costs of various the options for treatment. Floating hydrocarbons most likely will be skimmed from the groundwater and disposed of to an oil recycling facility. Alternatively contaminated water would be trucked to a waste water treatment facility.

- (m) **Contaminated plumes which are discovered should be recovered, especially those that will contaminate the ocean.**

Response:

The proponent has committed to remediate groundwater contamination where this is considered practical, particularly it has committed to removing hydrocarbons that are floating on the groundwater surface that have originated from Lots 23 and 31. The proponent does not propose to remediate dissolved heavy metal and hydrocarbon contamination from lots 31, 34 and 35 as this is considered to be impractical. This is because pumping the contaminated groundwater would be unsuccessful given that the coastal limestone formation has solution cavities that would make the selective removal of contaminated groundwater very difficult to achieve. Even if this could be achieved the cost to treat large volumes of groundwater contaminated with relatively low levels of contaminants to suitable levels would be cost prohibitive as defined in response 2.1.a.

- (n) **Subsection 3.5 of the CER presents general information on nutrient levels, and other common water quality parameters but does not address heavy metal, pesticide and hydrocarbon contamination which has been shown to occur in the overlying soils. Although information on groundwater contamination is presented in Appendix B, this is not referred to in subsection 3.5.**

Response:

Section 3.5 provides information on basic groundwater quality parameters as distinct from contaminants that are discussed in Section 6.3 and detailed in Appendix B of the CER.

- (o) **The proposed approach to remediation in the CER is to remediate those areas as required (as determined by irrigation quality or health risk assessment) and to limit the use of groundwater by the use of caveats (clause 6.3.2). There does not appear to be sufficient information provided to assess the extent and time required for these remedial works. Also, the proposed monitoring programme appears to be open-ended without any required action other than reporting.**

Response:

Experience has shown that the time taken to remediate the hydrocarbons floating on groundwaters associated with the past use of Lot 31 will be in the order of twelve to eighteen months from commencement. Remediation of Lot 23 will be immediate as the oil in the bore is localised. Monitoring would continue until such time as the success of the remediation was shown.

- (p) **Concern was expressed that the CER has no proposed remedial measures for contaminated groundwater off-site, should it be shown that contaminants originating from the site are causing an adverse effect.**

Response:

It is considered that restricting groundwater use is the appropriate mechanism for managing contaminated groundwater that cannot be remediated.

- (q) **The CER does not address the proposed treatment of existing groundwater wells and bores at the site.**

Response:

The approach to remediation of the free product on lot 31 is outlined in Section 6.3.2 and lot 34, Section 5.3 of the CER.

- (r) **Validation of groundwater remediation, as discussed in clause 6.3.2 of the CER, is not addressed to the same extent as it is for soil remediation, and does not contain the same proponent commitment to meet DEP requirements.**

Response:

The proponent commits to monitoring the success of the remediation of the floating product. This will be done to the satisfaction of the DEP and the Water and Rivers Commission.

2.3 Groundwater contamination management:

Concern was expressed that the CER does not address the long term responsibility for the management of contaminated groundwater. Responsibility for the long term ownership of contaminated water needs to be appropriately assigned.

Response:

The owner of the properties that this assessment covers acknowledges current responsibility for groundwater contamination originating from the WAPC sites. However the issue of ownership of contamination is considered to be legal in nature and not appropriate for discussion in this forum.

3. MARINE SEDIMENT QUALITY

3.1 Marine sediment contamination:

- (a) Concern was expressed that the CER does not provide adequate detail on the:
- extent and nature of contamination for marine sediments;
 - assessment of contamination verses acceptance criteria;
 - sampling programme undertaken to define contamination; and
 - proposed clean up level of marine contamination. The City of Cockburn preferring removal of all contaminated sediment above the sediments effect value range low levels, to ensure that no future problems occur.

Response:

The CER directs the reader to the sediment sampling program performed as part of investigations for the potential Port Catherine marina for specific details regarding assessment of sediment contamination. This study is referred to in the CER. The DEP Southern Metropolitan Coastal Waters Study recommends a remedial management plan for sediments which exceed the ERM value. Removal of the sediments is not considered necessary as sediment sampling showed no contaminant concentrations in excess of the ERM value. A number of locations were above the ERL value which is acceptable to remain but requires a commitment to monitoring such areas and any impacts on the aquatic life.

- (b) Ongoing monitoring of marine sediment quality, together with an assessment of shellfish and marine species within the project area to determine whether contamination of biota is present, are also considered desirable by the City of Cockburn.

Response:

The results of the assessment work described in (a) above indicates no need for the monitoring suggested in relation to the remediation of the government owned properties.

Monitoring of marine sediment quality and aquatic life present is more appropriately addressed in the assessment of development proposals. The proponent understands that such work is to be undertaken in by the marina developer PCD as part of their marina sediment quality monitoring program . This is outlined in Section 6.4.2 of the CER.

However the proponent will commit to reassessing those sediments identified as in excess of the ERL. The purpose of reassessment is to confirm that the sediments are not simply migrating from one location to another due to littoral drift. Should levels still exceed the ERL, the criteria will be refined based on the form of arsenic (only contaminant) which may require a sediment monitoring program that will investigate the effects on aquatic life.

- (c) In the CER, the Executive Summary refers to low levels of arsenic located at the shoreline north of Ahoy Road & up to the northern boundary of the project area. However no information was provided in the report to substantiate this statement. A summary of sediment contaminant levels should be provided.

Response:

The proponent has provided to the DEP a table and summary detailing the contamination status of the sediments.

- (d) **Concern was expressed that the proposed site remediation criteria hierarchy outlined in the clause 5.1.3 of the CER needs to be altered to read:**
1. **Soil contaminant concentrations above ANZECC (1992) *Environmental Investigation B, Soil Quality Guidelines*;**
 2. **Soil contaminant concentrations above ANZECC (1992) *Proposed Health Investigation Level Guidelines*;**
 3. **Soil contaminant concentrations above Dutch (1983), *B level Guidelines for Soil Remediation (1983) for the Assessment of Soil Contamination*;**

as the *Environmental Investigation B Soil Quality Guidelines* takes into consideration health and the environment, and is therefore more sensitive. It is also important that levels of contaminants in sediments which are not required to be excavated, are compared to the Southern Metropolitan Coastal Waters Study “draft environmental quality criteria for selected heavy metals and organic toxicants in sediments for the maintenance of ecosystem integrity”.

Response:

The Proposed Health Investigation Level Guidelines are now removed from the hierarchy. Sediments have been assessed against the draft environmental quality criteria.

3.2 Marine sediment remediation:

- (a) **Contaminated sediments not required to be excavated should be assessed according to the sediments effect value range low (ERL) and sediments effect value range median (ERM) values. In addition to continued monitoring, either criteria refinement or management intervention may be required.**

Response:

The CER directs the reader to the sediment sampling program performed as part of investigations for the Port Catherine marina for specific details regarding assessment of sediment contamination. This is provided in the CMPS&F Additional Environmental Investigations Report, October 1998. The DEP Southern Metropolitan Coastal Waters Study recommends a remedial management plan for sediments which exceed the ERM value. Removal of the sediments is not considered necessary as sediment sampling has shown no contaminant concentrations in excess of the ERM value. A number of locations were above the ERL value that is acceptable to remain. As already outlined in 3.1, the proponent will undertake a reassessment of sediment quality.

- (b) **In reference to clause 5.1.3 of the CER in establishing clean-up criteria for sediments, if sediments are found that exceed the sediment criteria, then the proponent is obligated to their remediation and must commit themselves to this.**

Response:

The CER directs the reader to the sediment sampling program performed as part of investigations for the Port Catherine marina for specific details regarding assessment of sediment contamination. The DEP Southern Metropolitan Coastal Waters Study recommends a remedial management plan for sediments which exceed the ERM value. Removal of the sediments is not considered necessary as sediment sampling has shown no contaminant concentrations in excess of the ERM value.

- (c) **The Water and Rivers Commission (WRC) supports the approach to marine sediment quality as stated in the CER. However, due to a wide range of industrial contaminants, a prevalence of nutrient contamination and the proposal to place onshore sediments in offshore environments the WRC recommend that the proponent conduct further research into the following:**

- **The applicability and accuracy of the guideline values on a site-specific basis.**
- **Possible synergistic effects of all the known contaminants entering the marine environment.**
- **Bioavailability of contaminants due to the presence of other contaminants in the sediments and those which would continue to enter via the groundwater system.**

Where dredging is to occur or where sediments are to be dumped into the marine environment, the WRC advises that it would be good practice to conduct these works in accordance with the *Guidelines for the Preparation of a Dredging and Dredge Spoil Management Plan - a Guide for Proponents, Waterways Guidelines No 9 December 1995*. General compliance with this document would minimise any impacts to the marine environment, when subject to these works.

Response:

The above question relates to works associated with development of the site, particularly the construction of a marina. The project that is the subject of this assessment is the remediation of government owned properties within the Port Catherine development area.

4 MARINE WATER QUALITY

4.1 Marine water contamination:

- (a) **Concern was expressed that the CER does not provide adequate detail on:**

- **the monitoring programme;**
- **the sources of contamination;**
- **the assessment and management of impacts of contaminated groundwater from the site on marine water quality in the long term; and**
- **explaining the modelling used to predict impacts.**

Response:

The proponent disagrees with the above statements and considers that the level of information is sufficient to plan the remediation of the government owned sites. The proponent has provided individual responses to each of these concerns in the answers to previous questions.

- (b) **The approach to the management of the monitoring of marine water quality and restrictions on fishing within the future marina, if these criteria are exceeded, is not considered adequate. This approach would restrict public access and use of the future marina. Effort needs to be made by the proponent with the aim of preventing pollution by dealing with the marine contamination sources, rather than ‘monitoring and restricting,’ as proposed in the CER.**

Response:

The above question relates to works associated with development of the site, particularly the construction of a marina. The project that is the subject of this assessment is the remediation of government owned properties within the Port Catherine development area.

The proponent proposes to remove the sources of contamination on the government owned sites and remediate groundwater contamination that can practically be treated.

- (c) **If the CER approach to management of the monitoring of marine water quality were to be adopted, then a detailed contingency plan, identifying actions required to deal with adverse water quality should be prepared, prior to any soil disturbance on the site.**

Response:

The project that is the subject of this assessment is the remediation of government owned properties within the Port Catherine development area. Monitoring and management of marine water quality within the marina is more appropriately addressed in the assessment of the marina. The proponent understands that such contingency plans are to be prepared by the marina developer PCD as part of their study on the marina proposal and will be presented in their documentation.

- (d) **If monitoring of marine water quality shows a risk to human health, how will fishing and other marine activities be restricted by the proponent?**

Response:

The project that is the subject of this assessment is the remediation of government owned properties within the Port Catherine development area. Monitoring and management of marine water quality within the marina is more appropriately addressed in the assessment of the marina. The proponent understands that such contingency plans are to be prepared by the marina developer PCD as part of their study on the marina proposal and will be presented in their documentation..

- (e) **Concern was expressed that there was insufficient detail provided in the CER subsection 6.5:**

- **advising how the flushing calculations were performed;**
- **giving an evaluation of nutrient loads entering the proposed future marina; and**
- **discussing the likely increase in risk of algal blooms or the presence of toxic algal species in undesirable quantities.**

Response:

The project that is the subject of this assessment is the remediation of government owned properties within the Port Catherine development area. Monitoring and management of marine water quality within the marina is more appropriately addressed in the assessment of the marina.

Attached to this response is a copy of the flushing calculations performed for BBG. An evaluation of nutrient loads cannot be performed as the final configuration of the marina has not been finalised, however the current discharge of nitrogen into the ocean is estimated at 5,600 kg/km of coast (see response 2.1.g).

- (f) **Concern was expressed by the Water and Rivers Commission (WRC) that overall the dilution argument in the CER is not a practical means of ensuring the protection of marine water quality, marine life and related human health effects. Instead the WRC would recommend that a site specific study and/or risk assessment be conducted to evaluate any effects on the quality of the marine environment.**

The WRC is concerned with the absence of detail related to the proposal to conduct water quality monitoring for the marine environment to determine any effects on marine water quality due to the influx of contaminated groundwater and recognises a potential to collect biased water samples that may show little or no effects of the influent contaminated groundwater.

Although the CER states that marine waters are likely to be maintained within acceptable quality limits through dilution and flushing and that the marine water quality will be monitored to ensure this, the WRC would like to express the following points:

- Although dilution and flushing effects have been considered, and form the basis of the assumption that groundwater remediation is not necessary prior to its discharge into the marine environment, the CER has not made any reference to research conducted on the synergistic effects, bioaccumulative effects and bioavailability of the known contaminants at the site, particularly for all of those contaminants that exceed aquatic protection guidelines.**
- The occurrence of very high mercury levels (a bioaccumulator) was noted to be a once-only occurrence and considered as a possible “artefact” without any reference to more rigorous investigations being conducted. The WRC recommends that further investigations be conducted to determine the extent of the mercury contamination.**
- The widespread occurrence of nutrient contamination in groundwater at the site has been recognised as a regional issue and appears to have been excluded from any further consideration of impacts to the marine environment without any possible synergistic or toxicity effects with other contaminants being considered.**

Response:

1. The proponent has proposed all the actions that it considers practical to safeguard the health of the public and the environment. It proposes to remove the sources of contamination on the government owned sites and remediate groundwater contamination that can practically be treated. It proposes to model the fate and transport of dissolved contaminants in groundwater emanating from lots 31, 34 and 35 Ahoy Road, and lot 51 Cockburn Road which are the only bodies of significant groundwater contamination. This is because pumping the contaminated groundwater would most likely be unsuccessful given that the coastal limestone formation has solution cavities that would make the selective removal of contaminated groundwater very difficult to achieve. Even if this could be achieved the cost to treat large volumes of groundwater contaminated with relatively low levels of contaminants to levels suitable for irrigation

would be cost prohibitive. Detailed studies of possible synergistic or toxicity effects with other contaminants is not considered to be of benefit.

2. The elevated level of mercury detected in one monitor bore installed on the boundary of lot 2076 and 1755 was retested on two occasions and found to be below the laboratory detection limit of 0.5 ug/l. The initial result is invalid.
3. Please refer to the response for point 1

BBG undertook groundwater testing off shore, the results of which are attached. In short, the groundwater quality is similar to what was observed in the coastal monitor wells: marginal exceedences of aquatic protection criteria up to a maximum of 6 times for lead. Based on a conservative dilution ratio 20:1, the maximum level within the mixing zone would be 30% of the aquatic protection criteria.

- (g) Concern was expressed that only very scant information was presented on marine water quality in clause 6.5.1 of the CER with reference to work by Bowman Bishaw Gorham. It is not clear from the information presented whether or not the marine water is contaminated. More information on the investigation programme and the results of the investigation needs to be presented to satisfy the EPA's requirement.**

Response:

The proponent considers that the information supplied is sufficient to conclude that the water quality within the marine environment does not exceed the aquatic protection criteria. Given a dilution ratio of 20 to 1, the maximum level of contaminants within the mixing zone would be 30% of the aquatic protection criteria. The actual dilution is estimated to be orders of magnitude in excess of 20 to 1.

4.2 Marine water remediation:

- (a) The CER does not show whether without the proposed future marina, the marine water quality on site is currently such as to constitute a risk to human health, or to increase the frequency of occurrence of algal blooms. If the presence of the marina actually exacerbates the risk to human health or the frequency of algal blooms, then the marina would not be considered as a desirable development from a marine environmental perspective.**

Response:

The proponent is not prepared to comment on the desirability of the establishment of a marina as this subject is outside the scope of the current proposal.

Monitoring has shown that the marine water quality is such that it does not constitute a risk to human health, The quality of groundwater entering Owen Anchorage was measured as part of studies performed as part of the environmental assessment of the marina. The results of this investigation are outlined in the BBG Site Contamination Assessment and Management Program, January 1998. Quality was reasonable with contaminant levels for metals, pesticides and hydrocarbons mostly below the aquatic protection guidelines. Exceedences occurred for copper, lead, mercury and nickel, up to a maximum of 6 times the aquatic criteria. It is predicted that dilution within the water body would very quickly reduce contaminant concentrations to below the aquatic guideline levels (see response 4.2.f). Aquatic criteria are more stringent than guidelines designed to protect public health.

- (b) The CER clause 5.1.4 statement that "where monitoring shows a risk to human health from the consumption of aquatic life, fishing will be restricted within the marina" is at odds with the statement in the same clause that "the**

marine environment ... within the marina will be maintained by ensuring the water quality is within guidelines set for ... human consumption of aquatic organisms (using the SMCWS criteria)”?

Response:

The reference referred to in the question is part of cross referencing that was required in the CER by the DEP. While the above statement may be true it has little bearing on the proposal to remediate the government owned sites as it is dependant on the water quality management in the marina. Monitoring of marine water quality and aquatic life present is more appropriately addressed in the assessment of the marina as it relates more to the construction and use of the marina.

- (c) In reference to subsection 5.2 of the CER in establishing clean-up criteria for soil, threshold criteria for remediation and any health risk assessment to soil contamination, particularly at depth, must recognise the potential for groundwater to be further contaminated. The criteria must also recognise the ongoing risk of detrimental affects on the marine environment.**

Response:

The proponent proposes to model the fate and transport of dissolved contaminants in groundwater emanating from lots 31, 34 and 35 Ahoy Road and lot 51 Cockburn Road. Detailed risk in relation to impacts in the marine environment will be considered as part of the proposed environment and health risk assessment of the deeper contamination in the limestone.

- (d) From the information presented in Section 6.4.1 of the CER it is not feasible to assess whether or not the conclusions presented about sediment contamination of sediments are reasonable. Also, there is no reference to the information on which the statements about contamination are made.**

Response:

The CER directs the reader to the sediment sampling program performed as part of investigations for the Port Catherine marina for specific details regarding assessment of sediment contamination. This information was included as part of a DEP requirement for cross referencing between documents. The DEP Southern Metropolitan Coastal Waters Study recommends a remedial management plan for sediments which exceed the ERM value. Removal of the sediments is not considered necessary as sediment sampling showed no contaminant concentrations in excess of the ERM value.

- (e) It is inferred in Section 6.5.2 of the CER that flushing will be sufficient to ensure that current and future groundwater contamination concentrations are sufficiently reduced as not to adversely affect aquatic life. However, there is insufficient information presented in the document to assess whether or not this flushing will be sufficient.**

Response:

The proponent has proposed all the actions that it considers practical to safeguard the health of the public and the environment. It proposes to remove the sources of contamination on the government owned sites and remediate groundwater contamination that can practically treated. The potential impact of the residual contamination will be predicted by modelling the groundwater of the lots 31, 34 and 35 Ahoy Road and lot 51 Cockburn Road. However even if the results indicate that the aquatic criteria are exceeded the proponent considers that remediation of groundwater in excess of that already proposed to be impractical.

5. DUST/PARTICULATES

5.1 Dust/particulates management plan:

The proponent should be required to produce a detailed dust management plan to ensure that dust is suitably managed on the site.

Response:

The proponent recognises the need to manage dust during the remediation and will manage the remediation to prevent unacceptable impacts from occurring. Dust management is straight forward and can be easily addressed through methods such as wetting down with water sprays and water trucks. The proponent commits to preparing a dust management plan.

5.2 Dust/particulates stockpiling:

Concern was expressed at the idea of stockpiling contaminated soil because of wind transport.

Response:

Materials will be handled on site to ensure that contaminated material does not get spread about the site. This can be dealt with by minimising stockpiling by loading material directly into trucks, keeping material damp, by watering stockpiles and if necessary covering them. The dust management plan will cover these issues.

6. PUBLIC SAFETY

6.1 Traffic

- (a) **Concern was expressed that the trucking route for carting of the contaminated soil to landfill be selected to avoid sensitive land use areas such as in residential areas and schools. The development of a management plan by the proponent is considered appropriate for managing the noise, vibration, dust generated and transport of contaminated material, as a result of traffic impacts occurring during remediation.**

Response:

Contaminated soils to be excavated as part of this proposal are not classified as hazardous goods because they pose insignificant short term risk to people. Correspondingly the proponent sees no need for special management plans for transport of the material as distinct to the excavation of the material. There are no residents within close proximity to the sites to be remediated thus issues such as nuisance vibration and noise are not considered to be a significant transportation issue. Trucks would travel along major roads which are used by trucks with a high frequency and thus no significant impact from the proposal is expected.

However as stated in response 5.2, the proponent will commit to implementing a dust management plan. A noise management plan will also be implemented with regard to remedial works.

- (b) **Concern was expressed that the CER did not nominate the Class IV landfill site to be used for the disposal of soil contaminants.**

Response:

The landfill to be used for disposal of material is dependant on commercial negotiations and these cannot be commenced until approval for the project is received. There is only one Class IV landfill in the Perth metropolitan area located in the foothills of the Darling Range.

7. OTHER

7.1 Environmental impact assessment of non - government land under Section 48 of the *Environmental Protection Act 1986*:

- (a) Concern was expressed that the CER did not address the management of decontamination for all land within the project area. The CER relies heavily on work undertaken for the non - government land, which forms part of the assessment under Section 48 of the *Environmental Protection Act 1986* for the Metropolitan Region Scheme Amendment Environmental Review (South - West Districts Omnibus No. 3, Amendment No. 991/33 to the MRS). Insufficient detail of this work is provided in the CER to adequately support many of the statements made.

Management of contamination for all land within the project area should be addressed in one document. This will eliminate confusion between the proposal and the approaches to management proposed.

Response:

The project referred to the EPA in January 1996 was the remediation of government owned land and as such the CER can only consider these sites. Approval to release the CER was gained formally from the EPA in March 1997.

The CER relies on the Section 48 assessment only in regard to elements that are relevant to the marina proposal. Cross referencing has been made in the CER documentation to facilitate general understanding of the two separate projects and how they interrelate.

The proponent considers that the level of information provided is sufficient for the general public to understand the proposal referred to the EPA in 1996. Confusion with regard to development of the land will be avoided by ensuring that the documentation for the Section 48 assessment is comprehensive.

Once the current proposal has been approved proponents of the development project will clearly understand how the remediation will be performed and under what environmental conditions. This will avoid any confusion and provide clarity to the general public.

- b) Concern was expressed that the proposal is being considered before the assessment under Section 48 of the *Environmental Protection Act 1986* for the Metropolitan Region Scheme Amendment Environmental Review (South - West Districts Omnibus No. 3, Amendment No. 991/33 to the MRS).

By undertaking this work now, the Western Australian Planning Commission (WAPC) will assume that Amendment No. 991/33 to the MRS will be approved. The EPA should require the WAPC to release the Environmental Review before it assesses this proposal.

Integrated planning and environmental management are essential to get the best result for the environment. This project is premature until the future use of the site has been decided by the EPA, and the EPAs recommendations accepted by the Minister for the Environment.

Response:

The proponent disagrees with the above statements. The proposal to remediate the government owned properties is independent of the proposal being dealt with under the Section 48 assessment. Should the development proposal not proceed the remediation will proceed. Consequently there is no need for the proponent to assume any approvals to implement the project.

The approach to remediation has been predicated on the land being used for the most sensitive which is residential. All contaminated groundwater that can be practically remediated will be remediated. As a consequence of these commitments being implemented the land will be suitable for residential use should the Section 48 assessment be successful. However, the opportunity exists to incorporate areas of residual contamination into landuses other than residential, such as public open space for flyash deposits. It should be noted that residual soil contamination left on-site is proposed at two sites based on the satisfactory outcome of a health risk assessment. This land would then be considered suitable for residential and there would be no need to restrict the utility of these sites based on perceived risk.

7.2 Compensation claim pursuant to Section 47B of the *Land Acquisition and Public Works Act 1902* on Lot 34 Ahoy Road.

Concern was expressed by Coogee Chemicals that the CER:

- In Appendix B, subsection B1.8; did not adequately summarise Lot 34 Ahoy Road; in which they have an interest. Coogee Chemicals have a strong pecuniary interest in the review process, as the land is the subject of an ongoing dispute with the proponent; and the amount of compensation payable may be related to the remediation costs for the site.
- On remediation of the land including Lot 34, should be undertaken, while matters of a technical nature are still pending before the compensation court.

Response:

The proponent has no comment to make regarding the above legal matters.

7.3 Principles/objectives of the project agreement between the Western Australian Planning Commission and Port Catherine Developments Pty Ltd (PCD).

Concern was expressed that there:

- does not appear to be a basis to conclude that the CER wholly reflects the requirements and intent of the project agreement; and
- is not sufficient information provided in the CER to be confident that the Government land holdings are totally remediated and unconstrained.

PCD advised that:

- they have been allowed only limited access to details of Contaminated Site Assessments for Government lands; and
- not only do investigations over some sites in the CER appear limited and inconclusive, but also there is insufficient evidence provided to be able to evaluate many of the claims.

Response:

The agreement between the two parties is considered beyond the scope of the environmental assessment. Substantial investigations have been performed in response to questions raised regarding the proposal and the results indicate no other substantial contamination than was identified in the investigations reported in the CER.

7.4 General project principles

- (a) Concern was expressed that from the CER it is evident that there is no conclusive reference that remedial works will be completed to the level of the relevant guidelines. All references to the nominations of “clean-up criteria” describe establishing “sites specific clean-up criteria” using the guidelines as a reference base. The only commitment that is made is that where levels exceed guidelines, that further testing and sampling shall be undertaken. This then provides no conclusive indication as to how or what level of clean-up the actual remedial works will achieve.

Response:

The proponent commits to remediating the government owned sites in accordance with the guidelines quoted as relevant in the CER.

- (b) Concern was expressed that the CER did not make a distinction between how the proponent proposes to remediate shallow contamination and how they intend to deal with contamination “at depth.” The CER should explicitly identify levels of guidelines or specific higher levels of criteria, or otherwise explain that the remediation levels will be the same or similar to the process for risk assessment. The proposal in the CER to leave potentially deep sources of serious contamination insitu and unremediated is not supported. A health risk assessment approach is unacceptable if it fails to achieve levels of remediation that result in certain parts or aspects of the project area being constrained in some way.

Response:

The proponent commits to remediating the government owned sites in accordance with the generic guidelines quoted as relevant in the CER (now excluding the ANZECC health investigation levels) and the proposed risk guidelines to be generated for Lots 31, 34 and 35 Ahoy Road.

7.5 Inadequacy of CER

- (a) It is not possible to properly assess the adequacy of the works undertaken as per the CER or the validity of the claims, conclusions or projections that are based on the works undertaken. There is insufficient evidence provided to support the analytical results that are claimed, nor is there descriptive detail of the physical site testing and sampling methodology.

Response:

The proponent does not agree with the above statement. It considers that the work reported and referenced in the CER and performed in subsequent studies to be sufficient to meet current acceptable standards and to plan the remediation of the government owned properties.

- (b) **There are frequent references in the CER to original consultants' reports that advisedly provide the foundation for many of the conclusive statements, however none of these are appended to the CER, nor are they readily or publicly available. To date, copies of all of the relevant reports pertaining to the site are unobtainable, and those that have been made available have not been complete. It is doubtful whether the general public have had a reasonable opportunity to access and evaluate the source data and rationale that has formed the main foundation of the CER.**

Response:

The proponent has received no requests from the general public for the reports that are summarised in the CER. It is considered inappropriate to supply all the reports in their full form in the CER as this would result in the CER being an unmanageable document. The vast majority of these reports would be difficult for the general public to understand in their current form and it is considered that the summary presented in the CER facilitates a good understanding of the proposed remediation. The proponent welcomes requests for further information.

- (c) **The CER makes references on at least three instances to the provision of a "contingency plan" in regard to maintenance of groundwater quality. There is no such "plan" that is further described in the document. It does not indicate what the intent, the structure or the method of implementation of such plan may be. There is also no reference as to which party or authority is proposed to be responsible for the implementation of this plan. Associated with this reference to a "contingency plan" is the proposal for a groundwater monitoring programme for the marina/waterways. There is also no reference as to which party is responsible for this programme. There are also numerous references for the provision of onshore monitoring programs, but no commitments for which party is responsible nor the extent of the anticipated programme.**

Response:

The reference to contingency plans is general in nature and is used to describe action that may need to be taken should unexpected problems with regard to groundwater quality develop. The CER discusses foreseen problems and the actions that will be taken with regard to remediation. Actions to resolve unanticipated problems cannot be predicted and thus cannot be described in detail.

Issues related to the management of water quality within any proposed waterway is considered to be independent of this proposal. The above question relates to the agreement between PCD and the Ministry for Planning and is beyond the scope of the environmental assessment.

- (d) **There is a reference in clause 5.1.2 of the CER, that implies that Port Catherine Developments Pty Ltd (PCD) shall be responsible for any such monitoring programmes or contingency plans to check the influx of contaminated groundwater emanating from government land. Whilst PCD shall implement a marine water quality monitoring programme and have satisfactory management plans, this is not intended to underwrite any Western Australian Planning Commission (WAPC) responsibilities. If this is the intent of the CER, then it is not acceptable to PCD. In the event that ongoing sources of high level contamination to groundwater in WAPC lands are not fully remediated, then WAPC must be responsible for any subsequent monitoring and contingency plan requirements and potential liability.**

Response:

The above question relates to the agreement between PCD and the Ministry for Planning and is beyond the scope of the environmental assessment. However, the proponent does take responsibility for monitoring and managing contamination originating from WAPC sites.

The proponent commits to monitoring marine water to confirm the statements made in the CER on the effects of groundwater input from WAPC sites and the impact of contaminated sediments on the marine environment. It should be noted that impacts on the marine environment result from a combination of sources outside of the control of the proponent including PCD sites, contaminated sediments and ambient water quality within Owen Anchorage.

- (e) **It is not clear from the CER which party is liable in the event that a future monitoring programme established a significant health (or other) risk due to inadequate remediation of government lands?**

Response:

It is the proponents responsibility to ensure that the government owned land is remediated in accordance with the requirements of the EPA and the relevant environmental legislation. Refer to response 7.5.d.

- (f) **The CER has not:**

- **identified an ordered sequence to the “site by site” staging of the remediation, if necessary; or**
- **discussed the proposed treatment of disused discharge pipes and drains into Owen Anchorage;**

as required by the EPA Guidelines (Refer CER Appendix A).

Response:

The sequence of remediation and demolition of structures on government properties will be decided by contractors which will perform the work. The proposed remediation will not be impacted upon by any particular order of remediation of the sites. The sequence of work is not expected to have any implications with regard to environmental impacts.

The demolition of structures is considered to be outside the scope of the environmental assessment. However all structures which occur on government owned property will be demolished by the property owner. Environmental investigations will be performed beneath all such structures once removed and prior to remedial works commencing.

- (g) **From the information presented in the CER:**

- **there is not a high level of confidence that the contamination investigations have established the nature and extent of contamination, and**
- **it is not feasible to make a judgement on whether or not the conclusions about contamination are reasonable and justifiable.**

It is expected, however, that if further details of investigations, which are currently available, are presented in a format that is readily understood, then:

- **the level of confidence would increase substantially; and**
- **such a judgement could be made.**

Response:

The amount of information presented in the CER on each government owned site is considered sufficient to plan remediation of the sites and inform the general public of the relevant environmental issues and how they are to be resolved.

Further work was performed in response to the questions raised during the public review period. The results of this work are reported in the responses to the questions and in the CMPS&F report: Additional Environmental Investigations for Port Catherine, South Coogee, October 1998 which has been provided to the DEP. Generally this recent work confirmed the estimates made of the nature and extent of contamination and thus support the conclusions made in the CER regarding the requirements for remediation of the land.

Estimates of the volumes of contaminated material at each location were conservatively calculated given the experience gained from remediations performed elsewhere in Western Australia. This was done to ensure that the cost to remediate the government sites was not underestimated and that the proposed remediation was financially feasible.

The information gained by the various environmental investigations has been compiled into a tabular format detailing both the soil and groundwater contamination status which has been provided to the DEP.

7.6 Inconsistencies in the CER

- (a) The CER makes frequent reference to “proposed” clean-up criteria” in regard to remediation levels for contamination. In subsection 4.4 of the CER, under the Health Risk Assessment Option, the final paragraph seems to advocate that the adoption of ANZECC Guidelines is the most effective management strategy. It should be made clear for the benefit of public understanding, exactly what method of evaluation is proposed by the proponent in the CER.**

Response:

The hierarchy of the proposed clean-up criteria now excluded the ANZECC health investigation levels. Where the generic clean-up criteria is not followed, a site specific environment and health risk assessment derived criteria will be followed.

- (b) The CER acknowledges that the government lands must be remediated to suit residential purposes in the context of the Concept Plan, but then advises that it may not remove high level contamination at depth that can be a continuing source of groundwater contamination to the marine environment. This can not be regarded as remediating to comply with “the purposes of the Project”.**

Response:

The above question relates to the agreement between PCD and the Ministry for Planning and is beyond the scope of the environmental assessment. The issue raised however is answered in the responses to previous questions.

- (c) **The CER advises that there are only 5 major contaminated sites and yet fails to identify Lot 43701 or Lot 2076 as contaminated. These lots have been major locations of flyash disposal and should also be remediated to suit the purposes of the Project. The flyash is geotechnically unstable, creates a major source of noxious dust pollution, contains heavy metals, increased acidity and possibly PCB's (refer CER).**

Response:

Please refer to the attached flyash study. The issue of geotechnical stability is not an environmental factor and is outside the scope of the CER.

- (d) **While the CER advised that lot 43701 was a major location of flyash disposal, it also identified that it was likely that it could have been a disposal location for other waste, such as PCB's. The CER advises that the potential affected area could be around 12 000m² and their data relies on one much earlier sample undertaken by Western Power and one new surface sample taken outside of the flyash area. Additionally, the four bore holes nominated as part of the investigation for lot 43701 appear to have been installed in the adjacent lot 2076 (refer CER figure W). These are outside of the flyash dumping area and yet one of these bores still encountered flyash to a depth of 4m on the beach reserve area.**

Clearly the flyash affected area is more extensive than anticipated and has impacted the beach area. Flyash is an unacceptable contaminant both for the public and the Project and given its proximity to the beach and marine environment in lots 43701 and 2076, must be remediated and removed from site. There is inconclusive data and insufficient sampling to substantiate the conclusions reached by the CER.

Response:

Please refer to the attached flyash study

- (e) **The List of Environmental Commitments table in the Executive Summary of the CER contains no definite commitments for the clean-up of contamination. Commitment 1 identifies an intent to undertake "sampling" and Commitments 2 to 7 basically involve safe work practices and methodology. Given that after the assessment process, the only part of the CER that publicly and formally survives is the Commitment Schedule, then it is appropriate that it should contain very specific commitments towards the remediation of contamination.**

Response:

The proponent commits to remediating the government owned properties in accordance with the relevant guidelines quoted in the CER and the revised list of Environmental Commitments, dated 30 September 1999.

- (f) **The subsection 1.1 of the CER implies that while only a portion of the government land requires remediation (previously noted as 6%), that the whole 9.79 ha of Port Catherine Development Pty Ltd land will need remediation. The actual amount of PCD land requiring remediation is much less (that is, up to 1.5 ha), yet these statements do not properly represent the respective magnitude of contaminated areas to be remediated.**

Response:

The extent of remediation required on non-government owned land is beyond the scope of this assessment. The area nominated refers to the size of the PCD land and does not necessarily represent the area of land that will be remediated.

- 7.7 Past experiences of decontamination at East Perth, Minim Cove and Ashfield.**

The decontamination process is likely to be more complex than anticipated, judging by the past experiences at East Perth, Minim Cove and Ashfield. Residential development of the site is not supported by the Conservation Council of Western Australia unless all major sources of toxicants are cleaned up, including contaminated groundwater plumes.

Response:

Most of the contamination is superficial and few technical problems are anticipated. Estimates of the volumes of contaminated material at each location were conservatively calculated given the experience gained from remediations performed elsewhere in Western Australia. This was done to ensure that the cost to remediate the government sites was not underestimated and that the proposed remediation is financially feasible.

- 7.8 Sampling methods, results of analysis and methodology for defining contaminants with quality assurance program.**

Concern was expressed that although subsection 3.2 of the CER provides a general overview of the various approaches to investigations undertaken by several consultants over about the last five years, and some very general information presented in Appendix B; there is no outline of sampling methods, results of analysis or methods defining contaminants with quality assurance programs.

Response:

If detailed information on sampling methods, results of analysis or methods and quality assurance programs are required reference should be made to individual site assessment reports referenced in the CER. These can be obtained from the proponent.

**ADDENDUM TO THE PROPONENT'S
RESPONSE TO ISSUES RAISED
IN PUBLIC SUBMISSIONS**

The following items are replies to general issues arising from our draft response to public submissions. Points relating to specific questions are discussed in the final issue of our response to public submissions document.

In addition, a revised version of the flyash study is included which takes on board the comments of the WA Health Department.

1.1 SOIL CONTAMINATION General Comments

1. Flyash samples were taken generally over 1 m intervals, excluding any surface sands or such. A statistical analysis of the analytical results of the work is provided in the flyash report which is attached. Full details of the investigations are provided in the Additional Environmental Investigations report.
2. Barium in the groundwater underlying the flyash is below the raw water drinking guidelines of 1 mg/l and 0.7 mg/l for public drinking water supplies. There are no aquatic protection or irrigation criteria for barium. The other heavy metal elements associated with the flyash, these being copper, nickel and zinc were not detected in groundwaters at concentrations above the aquatic protection criteria.
3. The proponent considers that the flyash deposits are unsuitable for residential development based primarily on the geotechnical unsuitability of the material. The issue of barium concentration would also preclude residential development without remediation or management. Those lots subject to an environmental and health risk assessment (lots 31, 34 and part of lot 35) will be remediated to enable use for residential residential purposes.
4. The additional contaminated areas relating to lots 27 and 50 will be revised on the respective maps and provided to the DEP.
5. Soil samples from a number of sampling locations on undeveloped lots were not tested. The purpose of these soil bores were to determine the presence of dumps or fill as the contamination potential of these sites was negligible. However a number of soil samples were analysed to confirm this assumption.

1.2 GROUNDWATER CONTAMINATION General Comments

1. Pump and treat options are typically the most inexpensive approach to remediating contaminated groundwater. Containment walls and interception trenches can be built but are extremely expensive. A recent WA project (Omex site remediation) involving the installation

of a cutoff wall into clay cost in the order of 2 million dollars (\$250/m²) to construct. To construct such a barrier in limestone would be extremely problematic, and may not even be achievable. Costs in the order of five times that for a clay medium would be expected.

2. Phenols were tested for in areas with the potential for such contamination. No exceedences above aquatic guidelines were detected. Extensive soil testing showed phenols not to be an environmental problem. This is not surprising as phenols degrade rapidly in the presence of oxygen. With discussion in the CER, phenols have been included in the hydrocarbon category.
3. The free phase hydrocarbon contamination detected on lot 31 is restricted to immediately downgradient of the now removed underground storage tanks. Dissolved phase contamination at levels considered unsuitable for drinking purposes was found in only one of the three groundwater wells installed 10 m downgradient. The free phase has not migrated this distance and remains localised as all three wells were found to have no free phase contamination. The contamination is most likely contained within a vuggy feature which is poorly interconnected. Groundwater flow in the Port Catherine area is estimated at between 65 m and 175 m year. This variability is a function of the presence of caverns and fissures.
4. The proponent concurs that protection of the marine environment of Owen Anchorage from contaminated groundwater is an important issue. The aquatic criteria quoted in the CER are considered to be the accepted measure to assess the potential for impact on such an environment with regard to discharges. It is understood that the criteria relate to the prevailing conditions within the water body and not specifically to discharges.
5. The proponent has undertaken in conjunction with the proposed developer, groundwater monitoring both off-shore and along the shoreline in order to determine the concentrations of contaminants entering the ocean. The proponent is confident that the concentrations of contaminants will not be in excess of the aquatic protection criteria due to the processes of dispersion and dilution at the point of discharge. This is because the discharging groundwater needs to be diluted only 20 times to be well within the criteria. The proponent considers that there is no benefit in calculating the contaminant loading values based on this monitoring given conformance to the aquatic criteria.

The investigation work has shown that there are no defined plumes with the exception of lots 31, 34 and part of lot 35. The proponent has committed in the CER to undertake groundwater fate and transport modelling for sites which exceed irrigation criteria and have well defined groundwater plumes. The model will predict the contaminant concentrations entering the ocean over the life of the plume.

1.3 MARINE SEDIMENT QUALITY General Comments

1. A comparison of the sediment contaminant levels against the SMCWS draft criteria is provided in Table 11 of the Additional Environmental Investigations Report inclusive of sampling locations. This is discussed and assessed in the same report in Section 4.10: Decommissioned Ocean Outfalls.

2. The construction of the marina is outside the scope of the current assessment. However the CER (Section 5.1.4) provides information on where sediments are to be buried or removed as part of the marina development for information and as required by the DEP in relation to cross-referencing.
3. The results of the sediment sampling program have been issued to the DEP as per response 1 above.

1.4 MARINE WATER QUALITY General Comments

1. The criteria which would be applied in the ocean (marina if developed) are the Southern Metropolitan Coastal Waters Study Draft Environmental Quality Criteria for a multiple use zone which are the maintenance of ecosystem integrity (EQO Class II & III) and maintenance of aquatic life for human consumption (EQO 3). There are no proposed HIL criteria for marine water quality (see Section 5.1.4 of the CER).
2. The proponent acknowledges that it is responsible for groundwater contamination originating from WAPC sites. Responsibility for contaminated sediments cannot be so readily defined.

1.5 OTHER General Comments

1. The proponent understands and concurs with the statement.
2. The Additional Environmental Investigations report includes all the information used in the flyash study presented with these responses. They are found in Section 4.2 and Appendix D detailing the barium health risk assessment. Additional information the DEP requires which is not included in the CER, Environmental Site Assessment report, May 1998 and the Additional Environmental Investigations report, October 1998 are:
 - an up to date map showing all groundwater sampling locations;
 - the BBG results for the off-shore groundwater monitoring; and
 - revised soil contamination maps for lots 27 and 50.
1. Tabular information for each site showing the soil and groundwater contamination status of each site is provided with these responses.
2. The CER describes the strategies and approach for remediating contaminated soil, groundwater and sediments. This includes a description of the nature and extent of the contamination which is provided as Appendix B. Environmental management tools for the remediation phase are described in Section 7. The purpose of the CER is to describe the proposed remediation approach for consideration and approval by the EPA. A site specific remediation clean-up plan would be developed by the contractor subject to DEP approval before works commence. Development of a site specific remediation plan for lots 31 and 34 is contingent on the outcomes of a HRA subject to the satisfaction of the DEP. The proponent considers that the CER and all other additional studies and responses provided to

the department provide sufficient detail on the remediation approach for soil, groundwater and sediment, and for management of marine water quality.

1.6 FLYASH STUDY

The extent of the flyash deposits on lots 43701/2076 and 109 have been determined. The boundary of the deposits were surveyed to provide an estimate of area. Depth was determined by soil boring. The extent of the deposits are estimated at:

lot 43701/2076	4,000 m ² by 1.5 m average depth, 6,000 m ³ volume
lot 109	3,500 m ² by 9 m average depth, 31,500 m ³ volume

Flyash deposits on lot 109 extend onto adjoining railway land to the east. The total area of the deposit is 7,500 m² of which 3,500 m² occurs on WAPC land.

The flyash deposits have been the subject of intensive testing for heavy metals, PCBs and radiological contaminants. A total of 27 flyash and flyash impacted soil samples have been submitted for laboratory analysis as part of the site investigations. A number of the flyash samples contain minor concentrations of metals at up to 1.5 times the ANZECC B environmental guideline. Elevated levels of barium were found in all undiluted flyash samples as distinct from a number which had been mixed in with the insitu sand. PCBs were not detected in any flyash sample. The radiological status of the flyash is very low with observed gamma counts three orders of magnitude below disposal criteria.

The issue of barium should be assessed in terms of impact on human health given that the redevelopment is for residential. Observed barium concentrations were up to 12 times the Dutch Intervention criteria. The human health impacts associated with barium arise from both ingestion and inhalation exposure routes.

The risk posed to human health from the barium can be evaluated using a generic health risk assessment approach. Application of a health risk assessment can be performed based on the approach taken in the development of the national health investigation levels (National Environmental Health Forum, 1996). Protection of health is based on the most sensitive potential receptor being a young child who consumes a small quantity of soil daily. Appendix D outlines the derivation of a maximum allowable soil concentration for barium based on chronic oral exposure which will not produce an adverse effect in the health of the most sensitive receptor. For barium under a standard residential exposure scenario, the health based investigation level (HIL) is calculated at approximately 9,000 mg/kg assuming contaminated soil contributes 100% of daily intake.

The Health Department of WA indicates that contaminated soil should account for only 20% of the total daily intake and has applied a more conservative tolerable daily intake rate of 0.051 mg/kg/day from WHO compared to 0.07 mg/kg/day from the USEPA. This therefore reduces the HIL to 1,350 mg/kg. For public open space the criteria increases to 2,700 mg/kg, 5,400 mg/kg for high density residential and 6,750 mg/kg for commercial.

Calculation of inhalation health based criteria is not possible due to the limited number of human studies. However, review of available studies of occupational exposure to concentrated levels of barium in process industries report no significant health impacts (IRIS, 1998). Therefore ingestion is considered the primary mode for human exposure.

The observed levels of barium from 22 flyash samples (no soil) from the two disposal sites average 3,060 mg/kg. Maximum and minimum barium concentrations are 7,700 mg/kg and 71 mg/kg respectively. The standard deviation is 2,482 resulting in a 95% UCL of 3,930 mg/kg. The 95% UCL is above both the standard residential and public open space (POS) HILs. Therefore the elevated levels of barium present in the flyash require some form of remedial works unless these areas are developed as high density residential or commercial.

Geotechnically the flyash will be unsuitable for construction. The ANZECC Guidelines for the Assessment and Management of Contaminated Sites consider a 0.5 m clean soil barrier as adequate in most situations for protection of human health. Alternatively, a well maintained grass can provide an 80% reduction in exposure which would facilitate a potential HIL of 13,500 mg/kg for POS (ie: $13,500 - 10,800$ or $80\% = 2,700$).

Therefore the flyash deposits could be developed into POS by provision of either a 0.5m soil cover or a well maintained grass cover. Given the maintenance requirements associated with a grass cover, provision of a 0.5 m soil cover would be considered the better approach to long term management of the flyash deposits.

With regard to environmental considerations arising from groundwater, there are no marine aquatic protection guidelines. From a human health perspective, there exists the potential for ingestion of groundwater via domestic bores installed within the flyash, albeit highly unlikely. Testing of groundwater beneath the flyash at three locations indicates barium concentrations no greater than 50% of the drinking water guidelines. Levels of other metals were below the drinking water guidelines. Therefore continuous ingestion of groundwater would not represent a risk to human health.