Appendix 1
Geotechnical Site Assessment

Douglas Partners
Geotechnics • Environment • Groundwater

Integrated Practical Solutions

REPORT
on
PRELIMINARY GEOTECHNICAL SITE ASSESSMENT

STAGE 1- SALAMANDER WATERS
KANIMBLA DRIVE, SALAMANDER BAY

Prepared for
Hill PDA Pty Ltd
Port Stephens Council

Project 39079
JANUARY 2005

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ATTACHMENTS

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Project 39079
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21 January 2005

REPORT ON
PRELIMIARY GEOTECHINCAL ASSESSMENT
STAGE 1- SALAMANDER WATERS
KANIMBLA DRIVE, SALAMANDER BAY

1. INTRODUCTION

This report presents the results of a preliminary geotechnical assessment of a site proposed for Stage 1 of a proposed residential subdivision 'Salamander Waters', to be located off Kanimbla Drive, Salamander Bay. The work was carried out for Hill PDA Pty Ltd, on behalf of Port Stephens Council.

The purpose of the assessment was to provide a preliminary geotechnical assessment of the site, with respect to the proposed residential subdivision, and comprised the following components:

- Review of existing information regarding the site, including previous geotechnical investigations, information regarding former mining activities, aerial photographs, and published geological information of the general area;
- Carry out a site radiation assessment of the mined portions of the site;
- Undertake a walk over survey taking note of relevant geotechnical features; and
- Provide comments regarding the suitability of the site for residential development and recommendations for additional investigation prior to construction.

2. SITE IDENTIFICATION

The site proposed for Stage 1 of Salamander Waters is an irregularly shaped area of about 4.5 ha, located to the west of Soldiers Point Road. The area is bounded by the old Port Stephens Drive and the Salamander Waste Disposal Site (to the north), existing residential development along Kanimbla Drive and Soldiers Point Road (to the south and east) and an existing wetland to the west. The overall site is shown on Drawing 1 attached.

Ground surface levels generally fall towards the north-west with surface elevations ranging from about 12 m AHD on the southern portions to 4 m AHD on the north-western boundary.

Additional site description is provided in Section 5.

3. GEOLOGY AND HYDROGEOLOGY

Reference to the 1:250 000 Geological Series Sheet for Newcastle indicates that the site is underlain by the Quaternary Alluvial, which typically comprises gravel, sand, silt and clay.

A previous geotechnical investigation undertaken by Brink Associates (Ref 1) comprised the excavation of eight test pits, in 1998, to a typical depth of 1.7 m (Pits 14 to 21), the location of which are shown on Drawing 1. The investigation indicated that shallow ground conditions typically comprised thin silty sand topsoil, overlying loose sand, with some shallow sand filling in the central portions of the site.

Reference to the Port Stephens Acid Sulphate Soil Risk Map prepared by the Department of Land & Water Conservation indicates a low risk of acid sulphate soils on the site and that these soils would be expected at greater than 3 m depth. Limited shallow acid sulphate testing was undertaken by Brink Associates (Ref 1) which suggested the shallow soils were not acid sulphate soils.

The site is expected to be underlain by a unconfined sand aquifer. In general, groundwater flows on the site would be expected to occur in a north-westerly direction, flowing towards the adjacent Salamander Bay Waste Disposal Centre. There are a number of ponds/wetlands on the site which are expected to represent 'windows' of groundwater with the surface water level controlled to a large extent by the surrounding groundwater levels.

A number of groundwater monitoring bores have been installed around the landfill, including at least one within the Stage 1 site. The results of testing to 1997 are summarised in a report by CPMS&F (Ref 3), which was supplied by Port Stephens Council. The testing undertaken up to 1997 indicated elevated concentrations of total dissolved solids, nutrients, metals, total organic carbon (TOC) and absorbable organic halogens (AOX), for various samples taken downstream of the landfill, however not for the bore located upstream of the landfill (in Stage 1).

In summary, the groundwater downstream (to the north and west) of the landfill had been affected by landfill leachate, however the upstream bore within the proposed Stage 1 site was reflective of background groundwater quality.

4. SAND MINING

4.1 Minerals Sand Mining

Parts of Salamander Bay were mined for mineral sands by RZM in the 1970s and reference to RZM plans as well as aerial photographs, indicates that much of the site was subject to sand mining activities. The approximate extent of sand mining is shown on Drawing 1, and includes the southern portion of the site, as well as some activity in the north-eastern corner. The sand mining continued to the south of the site and most of the site of the existing development on Kanimbla Drive was subject to sand mining.

The sand mining process involved dredging of sands using a barge, floating at groundwater level, within a moving pond. The pond would be propagated by excavating at the front and deposition of sand tailings behind. No information is available regarding the depth of mining, however such mining was typically undertaken to about 10 m to 15 m depth.

The main geotechnical issues with mineral sands mining are deposits of fines at dredging level, loose sand tailings and the presence of radio-active residues. The minerals extracted (rutile, zircon, ilmenite and monazite) are primarily oxides of titanium, however monazite is a phosphate of radio-active rare earths including thorium, caesium and lanthanum. Localised concentrations of monazite can have radiation levels above natural or safe levels.

4.2 Sand Quarrying

Subsequent to the mineral sands mining, it appears that the site has been used as a sand quarry, to provide sand for building purposes. The date of the sand quarrying is uncertain. The approximate extent of sand quarrying activities is marked on Drawing 1, and was identified from the presence of steep batters in the sand, as described in Section 5.

5. SITE CONDITION

A walk over site assessment of the site was undertaken by a Senior Engineer on 3 November 2004. The following observations were made during the site walkover.

Much of the site appears to have been disturbed, with the possible exception of a stand of trees in the north-eastern portion as well as the existing wetland and surrounding mature trees in the north-western corner. A pond was observed within the stand of trees in the north-east corner of the site, with overall dimensions of about 30 m to 40 m by 3 m to 5 m (Photo 1). The wetland on the western portion of the site (Photo 2) is located within a localised topographic depression and at the time of investigation contained surface water.

Photo 1 – Pond in North-Eastern Corner of Site

Photo 2 – 'Wetland' on western fringe of site.

The central and south-eastern portions of the site generally comprised an undulating sandy ground surface with sparse low lying vegetation (Photo 3), which is probably associated with former sand quarrying activities on the site. A sharp 'cliff' line, ranging up to about 3 m in vertical height (Photo 4), is evident around portions of this area, and probably represents the edge of the quarried area. An area of mounded filling, up to about 3 m vertical height (Photos 5 and 6) was also noted within this area. The approximate extent of the mounded filling is shown on Drawing 1, however much of the sandy surface in this overall disturbed area may be shallow filling. Surface assessment of the filling indicated the material was primarily sand, however building rubble including bitumen, bricks, gravel, concrete fragments, scrap metal and plastic was also observed at the surface over the mounded surface as well as in scattered locations across the surrounding disturbed area. A shallow pond was observed to the east of the mounded fill (Photo 6).

Photo 3 – Open Sand Area in South-East Corner of Site

Photo 4 – Typical Steep Batter at Edge of Quarried Area

Photo 5 – Filling on Central Portion of Site

Photo 6 – Pond to East of Mounded Filling

The former Port Stephens Drive is evident along the northern boundary of the site and comprises a bitumen sealed surface with cleared shoulders.

The south-western portions of the site generally contained a shallow sandy topsoil supporting bushy vegetation and occasional mature trees (Photo 7). Based on the results of mapping this area appears to have been subject to mineral sand mining, however appears to have been unaffected by sand quarrying.

Photo 7 – South-Western Part of Site

6. RADIATION SURVEY

A radiation survey of the site was undertaken by Bartolo Safety Management Service, and comprised measurement of radioactivity on an approximate 15 m grid across the site. The results of the survey indicated measured radiation levels generally in the range 0.05 µSv/hr to 0.18 µSv/hr. Details of the radiation survey are provided in the attached report by Bartolo Safety Management Service.

A previous radiation survey was undertaken by Brink (Ref 2), in 1998, which indicated measured radiation levels across the site in the range 0.0 µSv/hr to 0.4 µSv/hr.

7. COMMENTS

7.1 Former Sand Mining Activities

There are a number of potential geotechnical issues related to mineral sand mining activities including the following:

- elevated radiation levels;
- loose sand;
- soft/compressible slimes layers.

Radiation

The results of a radiation survey of the site undertaken by Bartolo Safety Management Service, as attached, indicate measured radiation levels well below the NSW EPA action level of 0.7 µSv/hr for residential areas. The report concludes that there are not expected to be any constraints to residential development due to radiation. A previous radiation survey in 1998 (Ref 2) indicated similar results and conclusions.

Loose Sand and Slimes Layers / Lenses

Sand disturbed by mineral sand mining is typically redeposited in a loose state. In addition, there is potential for deposition of layers of 'slimes', which are concentrations of silt and clay fractions from the mined sand. The slimes layers are typically of low strength and can be highly compressible. The presence of loose sands and/or slimes layers has the potential to lead to increased settlements of building footings, when compared to an unmined site. Such settlements can typically be managed by one or a combination of the following methods:

- design footings to accommodate expected settlements;
- compaction of the upper layers of sand;
- excavation and removal of slimes layers (only practical for shallow layers);
- preloading of site by placing mounds of sand over the area of concern and allowing the majority of settlement to occur prior to removal the mounds and construction.

It is recommended that additional deep subsurface investigation be undertaken prior to construction to assess for the presence of loose sand and slimes layers, and development of an appropriate management strategy, if required.

7.2 Site Filling

It appears that the site has been subject to uncontrolled filling subsequent to sand mining activities. The extent of the filling is difficult to accurately assess, however appears the most substantial thickness is expected to be in the central portions of the site, as shown on Drawing 1, possibly with a thinner spread of filling across the south-eastern corner. Surface visual assessment of the filling suggests the material is primarily sand, however various inclusions including bitumen, bricks, gravel, concrete fragments, scrap metal and plastic were observed. Discussions with Mr Ian Gilkes from Port Stephens Council suggested that much or all of the filling was material excavated during construction of the Salamander Shopping Centre. It is understood that the material may be removed from site for use on the adjacent waste management site.

No obvious contamination was observed at the surface, however as the material has been sourced off-site there is some potential for the presence of contamination. Therefore it is recommended that sampling and testing of the fill material be undertaken to assess for the presence of contamination in order to confirm its suitability for re-use on site, or to classify the material for off-site disposal.

From a geotechnical perspective, the uncontrolled / uncompacted filling is not suitable for the support of structural footings and therefore if the material is to be re-used on site below building footings, appropriate reworking and compaction of the material will be required.

7.3 Slope Stability

There was generally no evidence of previous or incipient deep seated slope instability observed over the site. The site is generally considered to have a low risk of slope instability with respect to the natural topography, with the exception of the localised steep cuts into the sand related to the former sand quarrying activities, where there is a medium to high risk of localised instability. This risk could be reduced to low risk by undertaking earthworks to limit batter slopes to no steeper than 2H:1V.

It is therefore considered that the site is suitable for the proposed development with respect to slope instability, subject to localised remedial works.

In the event that significant cuts or fills are proposed for the site, further geotechnical investigation to specifically assess slope stability issues should be undertaken. Such issues are generally managed by limiting batter slopes, drainage measures or suitably designed support.

7.4 Acid Sulphate Soils

Based on the relevant Acid Sulphate Soil Risk Map and limited investigation by Brink (Ref 1) it is expected that there is a low risk of acid sulphate soils on the site and that these soils would be expected at greater than 3 m depth.

If significant excavation is proposed, including any excavation below the water table, it is recommended that an acid sulphate soil assessment be undertaken to determine whether acid sulphate soils require management during excavation. Acid sulphate soils are generally managed by treatment with a neutralising agent, such as agricultural lime.

7.5 Groundwater

Shallow groundwater is present across much of the site. The surface water observed in various low lying areas across the site is expected to be representative of the groundwater level. Groundwater flows are expected to be generally in a north-westerly direction towards the adjacent waste management centre (municipal landfill). The limited available contamination monitoring data suggests that the site groundwater may be largely unaffected by leachate from the landfill, however it is considered that there is some potential for leachate affected groundwater to enter the site. Various processes may account for possible leachate entry to the site, including natural localised variations in flow direction due to soil or climatic conditions. Any future groundwater abstraction from the site may have potential to result in a reversal of flow direction, which may lead to landfill leachate entering the site.

The groundwater data made available to date is pre 1997 information and therefore it is recommended that a detailed assessment of any subsequent monitoring information be undertaken to further assess the possibility of landfill leachate entering the site.

A groundwater management strategy should be developed for the site, in order to identify any restrictions which may be required to limit groundwater use on the site, in particular groundwater abstraction.

7.6 Summary

From a geotechnical perspective the site is considered suitable for the proposed development subject to appropriate engineering design and construction. Additional geotechnical investigation is expected to be required prior to construction which may include the following:

- deeper investigation of the area previously subject to mineral sand mining, to check for the presence of loose sand and slimes layers or zones;
- assessment of filling for presence of contamination;
- development of a groundwater management strategy, including a full review of landfill monitoring data;
- assessment of acid sulphate soils, if significant excavation is proposed;
- specific foundation investigation for proposed buildings;
- earthworks procedures and specifications;
- pavement thickness design for new internal roads.

DOUGLAS PARTNERS PTY LTD

Reviewed by:

Will Wright
Associate

John Harvey
Principal

REFERENCES:

1. Brink Associates, "Salamander Bay Projects, Proposed Residential Subdivision, Stages 16 and 17 Kanimbla Drive, Salamander Bay, Geotechnical Investigation and Pavement Thickness", 13 November 1998.
2. Brink Associates, " Radiation Survey, Stages 16 & 17 Kanimbla Drive, Salamander Bay", 23 November 1998.
3. CMPS&F, "Salamander Bay Waste Disposal Site Rehabilitation and Management Plan, Investigation Report", July 1997.

is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

LEGEND

- APPROXIMATE TEST PIT LOCATION
- BATTER SLOPE
- APPROXIMATE EXTENT OF FORMER MINERAL SAND MINING ACTIVITIES
- SITE BOUNDARY

DRAWING ADAPTED FROM SURVEY PLAN BY BISSETT & WRIGHT CONSULTING SURVEYORS, REF No 13661

0 25 50 75 m

SCALE 1:1500

Douglas Partners
Geotechnics Environment Groundwater

Sydney, Newcastle, Brisbane, Melbourne, Perth, Wyong, Campbelltown, Townsville, Cairns, Wollongong, Darwin

TITLE: SITE FEATURES
PROPOSED SUBDIVISION
OFF KANIMBLA DRIVE, SALAMANDER BAY

CLIENT: HILL PDA PTY LTD			REF:P:\39070\DRAWINGS\39079-1
DRAWN BY: PH	SCALE: 1:1500	PROJECT No: 39079	OFFICE: NEWCASTLE
APPROVED BY:		DATE:	DRAWING No: 1

RADIATION (Gamma) SURVEY OF THE PROPOSED SITE OF RESIDENTIAL DEVELOPMENT NEAR "OLD PORT STEPHENS ROAD" SALAMANDER BAY

Survey Conducted on 3rd November 2004

Survey conducted by

Bartolo Safety Management Service

PO Box 264 Jannali 2226 NSW
Phone: 02 9528 7676
Email: b.bartolo@fastlink.com.au

RADIATION (Gamma) SURVEY OF THE PROPOSED SITE OF RESIDENTIAL DEVELOPMENT NEAR "OLD PORT STEPHENS ROAD" SALAMANDER BAY

Surveyed 3rd November 2004

by
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Jannali 2226 NSW
Phone/fax: 02 9528 7676
Mobile: 0427 287 630
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Radiation (Gamma) Survey Of The Proposed Site Of Residential Development Near "Old Port Stephens Road", Salamander Bay

Introduction and Method

The area of the proposed development is in a region that had sand mining activities in the past. As such it would require monitoring for sites of elevated radiation levels. To achieve a reasonable monitoring of the site, BSMS proposed to conduct the survey in the manner of a grid pattern (of approx 15 metre intervals).

Since the site was only partly sand mined (see Attachment 2) and that the remainder of the area was "pristine" coastal forest including natural wetlands, the survey was conducted in manner that was generally determined on site dependent on the features of the environment, hence the variation in the spacing of the measurement lines (see Attachment 2 & 3). An additional measurement was conducted to point CP6 to ensure that along the sand mining boundary that there wasn't any residual contamination by TENORM (technically enhanced naturally occurring radioactive materials) from the sand-mining and any subsequent development.

The instruments used for this work were:

- Scintrex Portable Scintillation Counter Monitor, type BGS-1S (calibrated in June 2003)
- As a confirmation of any "high" counts a Radiation Alert "Inspector" (new and calibrated in June 2003)
- as a backup for any possible high readings (above 5 microSievert/hr) a Harwell Doserate Meter Type 975003-2 was kept in reserve for confirmation of levels, and
- a Magellan eXplorist 100 GPS unit.

The results of the monitoring would be compared to the limits as set in the following:

Relevant regulations and guidelines

The International Commission on Radiological Protection (ICRP) recommendations

The ICRP, an independent international body, recommends upper limits on acceptable radiation dose to workers and members of the public. These limits are accepted throughout the world and used as the basis of national laws and regulations. The most recent recommendations were published in 1991. (ICRP 1991).

This publication introduced a new concept that is relevant to this site; the concept of "intervention". Intervention applies to situations, such as abandoned contaminated sites, where "the sources of exposure and the exposure pathways are already present and the only type of action available is intervention".

These ICRP recommendations have been adopted by the National Health and Medical Research Council (NHMRC 1995) [now controlled by ARPANSA] for use in Australia. The relevant Commonwealth and State laws and Codes of Practice in turn adopt the NHMRC recommendations but not all have yet been amended to include the 1995 NHMRC recommendations.

NSW

NSW Radiation Control Branch Radiation Safety Information Series No 12: Clean-up and Disposal of Radioactive Residues from Commercial Operations Involving Mineral Sands

This document is based on the 1984 recommendations of the NHMRC and so does not necessarily reflect current thinking. It is also only aimed at active sand mining sites, not "out of control" situations. The Radiation Branch of the NSW EPA, however, has not yet produced a revised version.

Action levels are set:

- For high occupancy areas such as dwellings, schools (including playground), businesses factories etc. where occupancies by the same individuals occur regularly on a day by day basis, the remedial action level should be 0.7 μGy/hr at 1 m above the ground.
- For intermediate occupancy areas where occupancies are for a few hours per week by the same individuals or by differing individuals and for garden areas, the remedial action level should be 1.0 μGy/hr at 1 m above the ground.
- For roads paths, and other areas with intermittent occupancy the remedial action level should be 2.5 μGy/hr at 1 m above the ground.

Other States

Queensland

Queensland Health Policy Document: Radiation Dose Levels for Properties where Mineral Sand Residues are Deposited on the Ground

This document is of relevance because it was written in 1995 and incorporates the more recent ICRP concept of "intervention". For some of its recommendations, however, it still refers back to a 1984 NHMRC document.

For practices under control, where technically enhanced radiation sources of mineral sands are deposited on the ground the limits are:

- 0.1 μSv/hr above the natural background level for dwellings, schools, etc. and
- 0.2 μSv/hr above the natural background level for parks etc..

Thus the action levels for dwellings, schools, etc. would be 0.2 μSv/hr and for parks etc. would be 0.3 μSv/hr. Practices under control refer to situations where the mining company is still operating and has responsibility for the land in question.

For an "out of control" practice (i.e. an intervention situation), where the mining company is not still operating and has no responsibility for the land in question, the action levels including background are:

- for dwellings, schools etc., 0.6 μSv/hr,
- for parks etc., 1.0 μSv/hr and
- for roads and footpaths, 2.5 μSv/hr.

Western Australia

Radiation Health Branch of WA Mines Department Guidelines

The Radiation Health Branch of the West Australian Mines Department set (in 1988) Guidelines for remedial action in areas of enhanced background gamma radiation levels. The action level criteria are:

- for dwellings, 0.46 μGy/hr,
- for schools, 0.57 μGy/hr,
- for other areas, 0.7 μGy/hr,

- for roads, paths etc, 2.5 μGy/hr.

(Note: while the radiation dose units in the different State regulations are variously quoted in μSv (microsievert) or μGy (microgray) these units are identical for gamma radiation)

Background radiation

Low levels of naturally occurring gamma radiation occur everywhere. These levels are higher where the soil or rocks contain higher concentrations of the natural radioactive materials, potassium, uranium and thorium and increase at higher altitudes due to increased cosmic radiation.

Heavy Mineral Sands

Deposits of heavy mineral sands are found along ancient beach lines where wave action has concentrated the heavy sand grains. All the heavy minerals contain some of the naturally radioactive uranium and thorium series radionuclides.

The only mineral with a significant concentration of radionuclides is Monazite. Monazite is normally present at low concentrations in deposits of Heavy mineral Sands. The most common of the other minerals is limenite. The concentration of radioactivity in limenite is below the concentration that defines a "radioactive material" in NSW regulations.

The nature of the heavy mineral sand grains means that they are not readily soluble and that the radioactive gas, radon, is mostly retained within the grain. Thus inhalation of radon or the contamination of groundwater is not normally a concern in assessment of land contaminated with Heavy Mineral Sands.

Monitoring Results

As can be seen from the table of results (Attachment 1), the "normal background" level is peaking at 35 counts per second and averaging about the 20 cps (last line of table). Comparing this with the rest of the monitoring results shows that there are no locations that have much higher readings. The boundaries (refer to Attachment 2) are interesting in that there are regions of the boundary that have lower levels than background and are indicative of well conducted sand mining. The one boundary (CP1 to CP9) that did have "high" reading is associated with "Old Port Stephens Road" and is attributable to the radioactivity associated with dolomite (blue metal) used in the asphalt.

In general the "cleared" area in the centre of the site had levels about the 10-14 cps (approx. 50 nGy/hr dose rate) and the "pristine" areas (see Attachment 3) were about double this level (peaking at 35 cps, i.e. about 180 nGy/hr).

Discussion

The current state of the site has no radioactivity levels that would require remediation for residential use. The levels (other than on the road) are well below the 0.7 μGy/hr (i.e. 700 nGy/hr or 0.7 μSv/hr).

BSMS does have a concern that the area under consideration has been disturbed since the sand mining activities were completed without being surveyed for radiation levels. The central area of the site is relatively bare of vegetation and sand, and if the mining activities had finished by the mid 70's then it would be expected that the vegetation in this area would be greater than the estimated 5-10 year age of the trees and shrubs (see pic 1 in Attachment 5). Supporting this is the lack of erosion of the steep sides of the excavation along the boundary CP2 to CP4.

Also there is an area extending from Old Port Stephens Road towards the centre of the site that is elevated by the dumping of landfill from another site. The presence of asphalt and other road building material and by the presence of vegetation that is not found in an any other area of the proposed site (see pic 2) are good indicators for this.

If there were any points of significance in terms of elevated levels then these may have been removed along with the sand and may be causing a problem elsewhere. The dumping of "landfill" from another site does not appear to have changed any radiation levels.

SUMMATION

The results of the monitoring indicate that there are no areas of "contamination" giving higher readings than is permitted under NSW EPA Guideline 12 for use as "residential" areas. As such there is no barrier in terms of radiation for the use of this land for residential purposes.

REFERENCES

ICRP 1991 1990 Recommendations of the International Commission on Radiological Protection. ICRP Publication 60. Pergamon Press Oxford 1991.
NHMRC 1995 NHMRC: Recommendations for Limiting Exposure to Ionizing Radiation (1995). Radiation Health Series No. 39. AGPS Canberra 1995.

ATTACHMENT 1

MEASUREMENT RESULTS - DATA

Proposed residential development north of Manoora Close

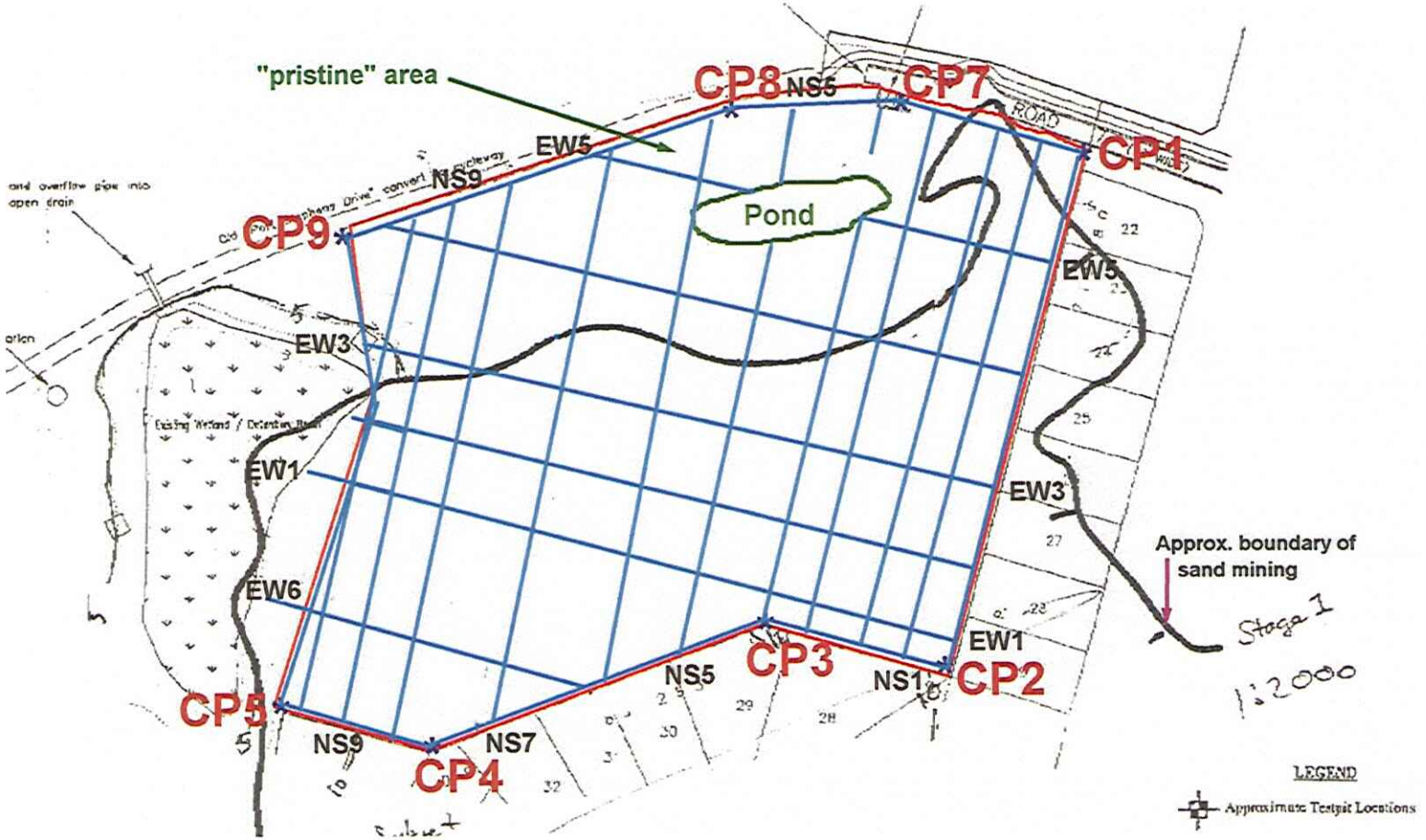
3 November 2004

line or site	Counts/sec	Dose Rate	Comments	Lat. & Long.
CP1	-	-	Reference point	32°43.956S 152°04.820E
CP2	-	-	Reference point	32° 44.037S 152° 04.838E
CP3	-	-	Reference point	32° 44.045S 152° 04.809E
CP4	-	-	Reference point	32° 44.087S 152° 04.757E
CP5	-	-	Reference point	32° 44.090S 152° 04.731E
CP6	-	-	Reference point	32° 44.204S 152° 04.797E
CP7	-	-	Reference point	32° 43,960S 152° 04.793E
CP8	-	-	Reference point	32° 43.964S 152° 04.770E
CP9	-	-	Reference point	32° 44.010S 152° 04.710E
East Border CP1 to CP2	10 – 20 cps	< 0.1 μSv/Hr (<100 nGy/Hr)		
South Border 1 CP2 to CP3	10-18 cps	< 0.1 μSv/Hr (<100 nGy/Hr)		
South Border 2 CP3 to CP4	6-15 cps	< 0.1 μSv/Hr (<100 nGy/Hr)		
South Border 3 CP4 to CP5	7 - 11 cps	< 0.1 μSv/Hr		
West Border CP5 to CP9	6 - 22 cps	< 0.12 μSv/Hr	Highest reading near asphalt road	
North border2 CP9 to CP7	11 - 35 cps	< 0.2 μSv/Hr (0.18 μSv/Hr on Rad Alert) (<200 nGy/Hr)	Influence of asphalt evident in readings, as well as un-mined minerals	
North border 1 CP7 to CP1	20 - 28 cps	< 0.14 μSv/Hr (<200 nGy/Hr)	Influence of asphalt evident in readings	
CP5 to CP6	6-22cps	< 0.12 μSv/Hr (<100 nGy/Hr)	This was measured to check on any influences such as mining.	
NS1 (10m from E. Border)	8-18 cps	< 0.1 μSv/Hr		
NS2	7-22 cps	< 0.12 μSv/Hr		
NS3	6-26 cps	< 0.13 μSv/Hr		
NS4 (CP3 to road)	10-15 cps	< 0.1 μSv/Hr		

NS5	6-11 cps	< 0.1 μSv/Hr		
NS6	7-25 cps	< 0.1 μSv/Hr		
NS7	8-25 cps	< 0.13 μSv/Hr		
NS8	8-22 cps	< 0.12 μSv/Hr	"northern" end greatly influenced by road	
NS9	10-25 cps	< 0.1 μSv/Hr	As above	
NS10	7-15 cps	< 0.1 μSv/Hr	As above but measurements stopped short of road. This line un-mined area.	
EW1 (10m in from CP2)	7-13 cps	< 0.1 μSv/Hr		
EW2	5-12 cps	< 0.1 μSv/Hr		
EW3	7-12 cps	< 0.1 μSv/Hr		
EW4	8-14 cps	< 0.1 μSv/Hr		
EW5	5-22 cps	< 0.12 μSv/Hr	Western end greatly influenced by road	
EW6	6-18 cps	< 0.1 μSv/Hr		
CP1 to CP8 Incursions to EW5	Peaking at 35 cps	<0.2 μSv/Hr	Natural background levels	

Attachment 2

Diagram of Approximate positions of Measurement Lines



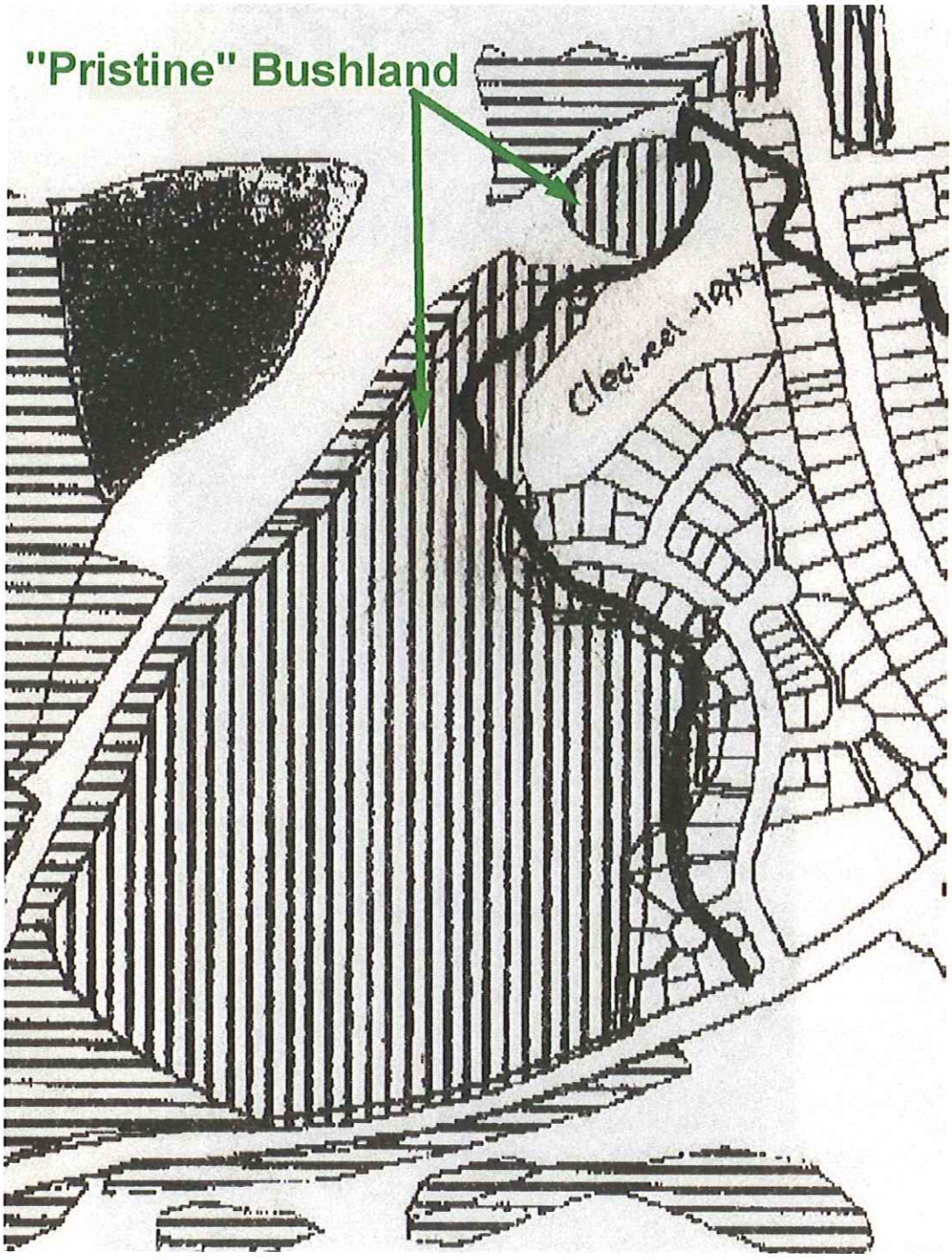
Note: the red line is the approximate boundary of the Proposed Stage 1 Development; the blue lines are the approximate locations of the measurement lines applied to the site. The land that is between Old Port Stephens Road and the approximate boundary of the sand mining is generally not modified by mining or other processes.

Attachment 3

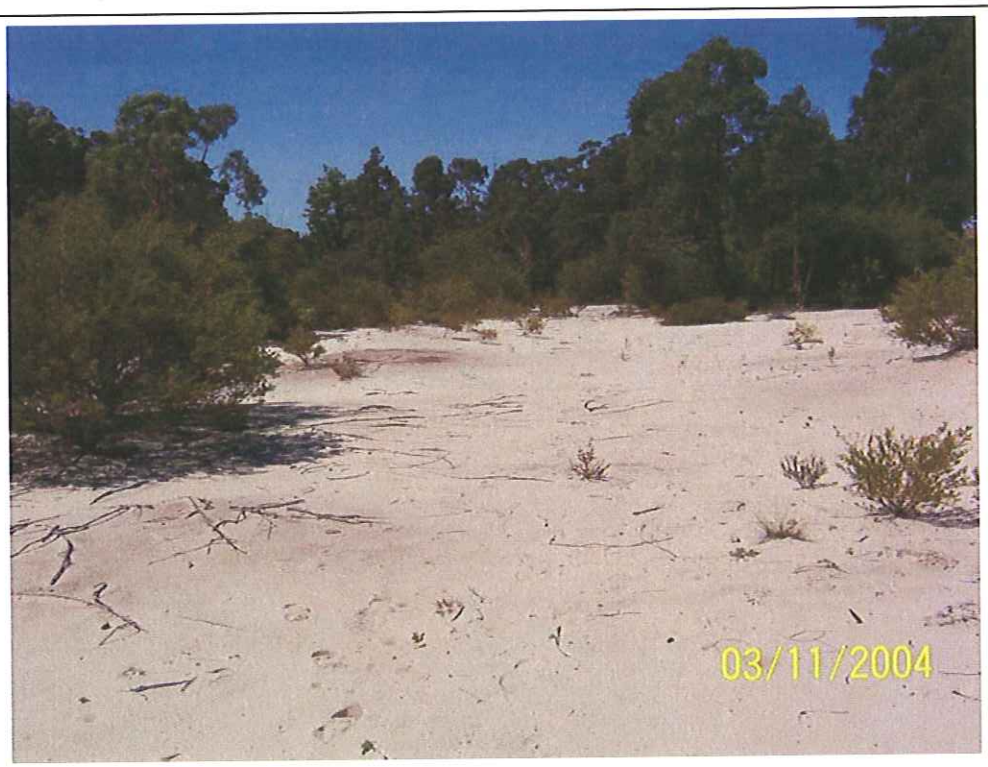
Diagram of Approximate positions of Reference Points

Attachment 4

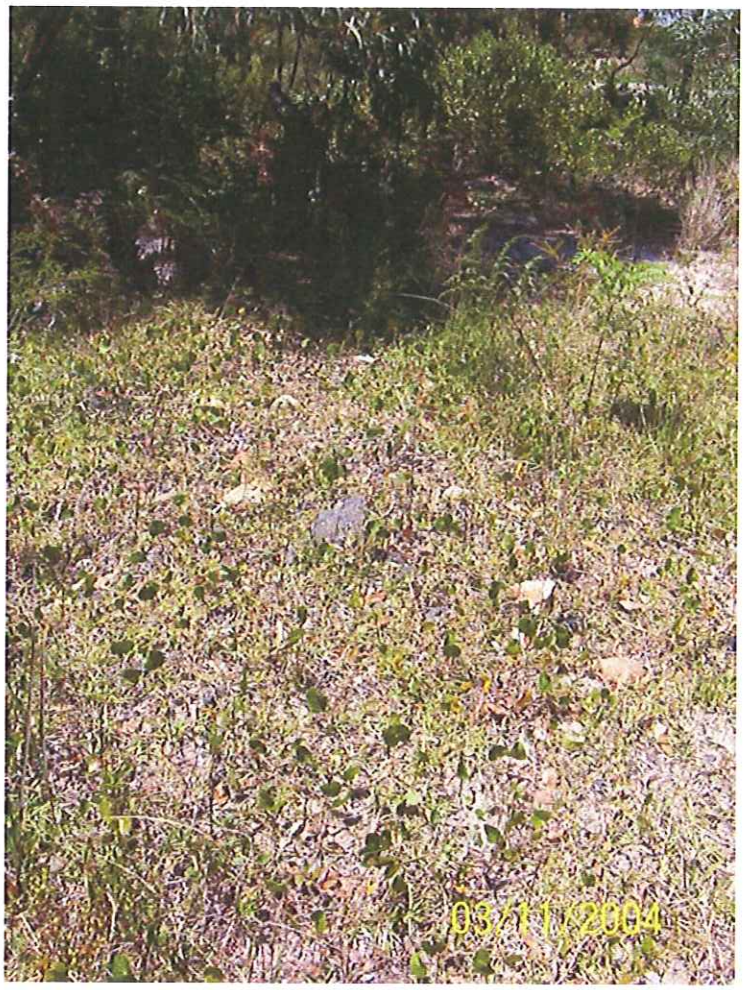
Location of relatively undisturbed Bushland/Forest



Attachment 5



Picture 1. Central area of site showing lack of re-vegetation.



Picture 2. From Top left: Picture shows change in topography from the landfill as well as the different vegetation (bright green patch), the slight elevation and gutter formed by the landfill and different vegetation; The rubble in the soil that includes road material not found elsewhere at the site, also note the presence of "Kurnell Curse" vegetation.