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Preliminary Contaminated Site Investigation

Proposed Multi-unit Eco-tourism Development
Lot 490 DP1095234, Casuarina Way Kingscliff NSW

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Conclusions to the report are professional opinions and LandPartners cannot guarantee acceptance or consent of the relevant determining/consent authorities.

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Executive Summary

LandPartners Limited (“LandPartners”) has been commissioned by Leighton Properties Pty Ltd (“LPPL”) to undertake a Preliminary Contaminated Site Investigation (PCSI) of Lot 490 DP1095234, Part 500 DP727420 and Part 489 DP47021 Casuarina Way, Kingscliff NSW as part of the proposed construction of a Multi-unit Eco-tourism Resort development, including community facilities and environmental conservation areas upon the abovementioned allotments (hereafter known as the study area).

A site inspection, desktop historical/current land use review and a Site Radiation Survey (SRS) were carried out in order to provide an appropriate and accurate characterisation of the site with regard to potential land contamination.

Historical imagery obtained from NSW Department of Lands (1947, 1962, 1972, 1987 and 2004) shows the site as former native coastal heath vegetation upon the coastal dunal barrier and supra/inter-tidal areas that have been extensively disturbed as part of heavy mineral sand mining activities conducted during the period circa 1943 to circa 1975. It is clear that significant filling activities have occurred upon lands within the eastern fringe of the Cudgen Creek with materials most likely sourced from local sand mining activities. Unconfirmed reports of stockpiled spoil heaps (reported during a site inspection conducted July of 1983) were identified during the site history review but efforts to locate corroborating documentation were unsuccessful (as at the time of reporting).

The site history and land use review of the study area identified the following Areas of Environmental Concern (AEC):

- Historical heavy mineral sand mining activities occurred across the majority of the study area; however, anecdotal evidence of mineral processing or tailings disposal was uncovered during this investigation. The presence of such activities (i.e. processing and tailings disposal) has the potential to allow the accumulation and concentration of Naturally-Occurring Radioactive Materials (NORM).

DPI (2004) data identified the presence of processing plants within adjoining lands (e.g. SALT development to the south of Lot 490). No definitive indications of the presence of tailings and/or processing plants upon the study area were found during this investigation with filling activities typically associated with re-soiling and reshaping works. Some filling of former dredge paths occurred as a part of natural tidal movement following a request from Tweed Shore Council in April 1971.

A review of previous reporting conducted for the SALT development site to the south (i.e. Cardno MBK 2002) identified radiation levels in excess of the normal background levels and the adopted Action Level Criteria (as per NHMRC 1992) and triggered the need for further investigations and remedial activities across the affected portions of this site.

A similar investigation was prepared for the current proposed developable area by Cardno MBK (2005) and found that surveyed areas within Lot 490 exhibit radiation levels equivalent to background levels and did not trigger the need for detailed investigations or remedial planning.

As a result of the site history and land use review, the potential for CoC associated with heavy mineral sand mining to be present on the remaining area of the Lot 490 site in concentrations representing a SRoH to end users was found to be significant. In accordance with this finding, a Site Radiation Survey was conducted (to complement the area previously investigated; Cardno MBK 2005).

No radiological values were measured in excess of the adopted site assessment criteria (refer s. 9.1) during the SRS conducted upon the study area. Surface radioactivity measurements ranged from 0.01 to 0.22 $\mu\text{Gy/hr}$ whilst near surface radioactivity measurements range from 0.01 to 0.18 $\mu\text{Gy/hr}$. Average surface and near surface radioactivity measurements were 0.1 and 0.09 $\mu\text{Gy/hr}$ respectively. The overall range of measurements across the surveyed area was between 0.01 and 0.27 $\mu\text{Gy/hr}$.

Based on the findings of this assessment and previous reporting (i.e. Cardno MBK 2005), the likelihood of a persistent contamination legacy resulting from historical mineral sands mining to represent a SRoH to end users is considered to be highly unlikely.

Nevertheless, this report and the investigations undertaken as a part of it have been conducted in accordance with the proposed development layout and design provided by LPPL. As a result, no requirement for subsurface investigations was identified during the preparation of this report. Should any substantial excavations be proposed within the south-western section of the study area, initial radiation investigations, including subsurface measurements are recommended to provide an appropriate safeguard to unearthing and redistributing potentially radioactive materials currently interred and undetected. Expert advice should be sought in the preparation and execution of such testing and analyses.

1.0 Introduction

LandPartners Limited (“LandPartners”) has been commissioned by Leighton Properties Pty Ltd (“LPPL”) to undertake a Preliminary Contaminated Site Investigation (PCSI) to accompany a Development Application to be submitted to Tweed Shire Council for the proposed subdivision of Lot 490 DP1095234, Part 500 DP727420 and Part 489 DP47021 Casuarina Way, Kingscliff, NSW (Figs. 1 and 2; Appendix 1).

1.1 Objective

The purpose of this investigation is to determine if the site has been potentially contaminated as a result of current and/or past land uses, as well assessing the study area’s suitability for the proposed development in regard to the requirements of State Environmental Planning Policy No. 55 (SEPP 55) – Remediation of Land (1998) and Section 2.3 of the Northern Rivers Regional Council’s (NRRC) Regional Policy for the Management of Contaminated Land (2007).

This investigation is a preliminary investigation, forming Stage 1 of a contaminated land assessment of the subject site in accordance with *Managing Land Contamination Planning Guidelines* (DUAP and EPA, 1998). If historical evidence collated and interpreted in this report indicates that contamination was unlikely to have occurred, then a Stage 1 investigation will be sufficient to satisfy the legislative assessment requirements for assessing potential risks to human health and the environment from the proposed land use. In contrast, should the PCSI identify activities undertaken upon the site that may represent a Significant Risk of Harm (SRoH) to end users and sensitive environmental receptors, the requirements for further investigations (*detailed site investigations*) and site characterisation will also be assessed.

1.2 Development Description

The Development Application involves the proposed construction of a Tourist Resort, community facilities and environmental conservation area on Lots 490 (hereafter known as the site), 489 and 500. The study area is Crown Reserve land gazetted as Crown Reserve for public recreation and coastal environmental protection.

The proposed development (as shown in Fig. 3; Appendix 1) is to comprise the following:

- 180 low-rise bungalows for tourist accommodation;
- A children's playground;
- An interpretive centre;
- Picnic shelters;
- Bikeways and bike racks;
- Pedestrian boardwalks;
- Public amenities (such as change rooms, toilets and showers);
- Improved beach and creek access; and
- New beachside and creekside car parking.

Approximately one third of the entire development site will be developed as part of the proposed Multi-unit Eco-tourism development, with the remaining two thirds of the site to be dedicated for environmental revegetation (with native endemic species), coastal reserves and community facilities.

2. Scope of Work

The investigation will include:

- The identification of past and present potentially contaminating activities through a review of available information held by relevant state and local authorities, as well as present and past landholders;
- The identification of potential Areas of Environmental Concern (AEC) and potential Contaminants of Concern (CoC) arising from historical land uses of the site;
- The identification of potential exposure pathways and nearby sensitive receptors (both environmental and human end users) appropriate for the proposed development;
- A comprehensive site inspection to assess the conditions of the subject site;
- A preliminary Radiation Survey Investigation (RSI) to characterise the level of contamination on site (if present) at surface and near surface;
- A preliminary assessment of the potential for site contamination within the study area and an assessment of the potential risk to identified receptors; and
- An assessment of the need for further detailed investigations and the provision of recommendations of the need for further assessment works.

The following relevant publications have provided guidance in the undertaking of the PCSI:

- ANZECC and NMHRC (1992) *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*;
- NSW EPA (1995) *Contaminated Sites – Sampling Design Guidelines*;
- NRRC (2007) *Regional Policy for the Management of Contaminated Land*; and
- NEPC (1999) *National Environment Protection (Assessment of Site Contamination) Measure (NEPM) Series*.

This Preliminary Contaminated Site Investigation report has been written in accordance with the requirements of NSW EPA (1997) *Guidelines for Consultants Reporting on Contaminated Sites*.

3. Limitations

The findings of this report are based on the objectives and scope of work outlined in Section 2. LandPartners performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental assessment profession. No warranties or guarantees expressed or implied, are made. Subject to the scope of the work, LandPartners assessment is limited strictly to identifying typical environmental conditions associated with the subject sites, and does not include evaluation of any other issues. This report does not comment on any regulatory observations based on the findings, for which a legal opinion should be sought. This report relates only to the objectives and scope of work stated, and does not relate to any other works undertaken for the client.

The report and conclusions are based on the information obtained at the time of the assessment. Changes to the subsurface conditions may occur subsequent to the investigation described herein, through natural processes or through the intentional or accidental addition of contaminants, and these conditions may change with space and time.

The site history and associated uses, areas of use, and potential contaminants were determined based on the activities described in the scope of work. Additional site information held by the client, regulatory authorities or in the public domain, which was not provided to LandPartners or was not sourced by LandPartners under the scope of work, may identify additional uses, areas of use and/or potential contaminants. The information sources referenced have been used to determine the site history and desktop information regarding local subsurface conditions. Whilst LandPartners has used reasonable care to avoid reliance on data and information that is inaccurate and unsuitable, LandPartners is not able to verify the accuracy or completeness of all information and data made available.

Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history, and which may not be expected at the site. The absence of any identified hazardous or toxic materials on the subject property should not be interpreted as a warranty or guarantee that such materials do not exist on the site. If additional certainty is required, additional site history or desktop studies, or environmental sampling and analysis should be commissioned.

The results of this assessment are based upon site inspections and fieldwork conducted by LandPartners personnel and information provided by the client. All conclusions regarding the property area are the professional opinions of the LandPartners personnel involved with the project, subject to the qualifications made above. While normal assessments of data reliability have been made, LandPartners assume no responsibility or liability for errors in any data obtained from regulatory agencies, information from sources outside of LandPartners, or developments resulting from situations outside the scope of this project.

4. Site Identification

The study area location, the subject site and the proposed development layout are shown in Figs. 1, 2 and 3 (Appendix 1) respectively with site identification and land use details provided in Table 1 (below).

Table 1. Site Details

Site Details	Comments
Site Address	Casuarina Way – Kingscliff, NSW.
Property Description	Lot 490 in DP1095234 Part Lot 489 in DP47021 Part Lot 500 in DP1095235
Local Government Area	Tweed Shire Council.
Current Zoning	• 2(f) Tourism in Tweed Shire Council Local Environmental Plan (2000) • 7(f) Environmental Protection (Coastal Lands) in Tweed Shire Council Local Environmental Plan (2000) • 7(a) Environmental Protection (Wetlands and Littoral Rainforest) in Tweed Shire Council Local Environmental Plan (2000) • Reservation of Crown Land #1002202 Gazette #6.11.1998 Folio 8707.
Elevation	Ranges from 2.0 – 8.0 m AHD.
Land Use – Existing	• Vacant, undeveloped land.
Site Description	• The site surface is undulating in nature and covered with native vegetation species not endemic to the area (Coast Banksia and Coast Tea Tree) and weeds (Lantana and Bitou Bush), consistent with rehabilitation endeavours associated with historical mining activities onsite; • Casuarina Way runs through the most northern portion and centre of site; and • Site is undeveloped land and has no onsite constructions.
Site Area	Approx. 43.4 ha

5. Site Environmental Setting

5.1 Topography and Hydrology

This original dune landscape has been extensively disturbed (as a result of sand mining for heavy mineral components) with the existing native vegetation cleared and replaced with exotic (Bitou Bush) and other non-locally occurring vegetation (Horse-tail Sheoak, Coastal Tea Tree and Coastal Banksia). The majority of the study area generally slopes between 1 - 8% with elevation between 1 – 10m AHD. An elevated area in the study area's south-western portion (refer Fig. 2) rises from the predominantly level land surface abutting Cudgen Creek to the west at an approximate slope of 25% (SW aspect) before gently reclining (1 – 4%) toward Casuarina Way.

The hydrology of the study area is dominated by Cudgen Creek which forms the western boundary of Lot 490. Cudgen Creek (~ 9kms) drains the perched tidal lagoon Cudgen Lake (~ 160 ha) with the catchment of Cudgen Lake and Cudgen Creek approximately 66 km². Cudgen Creek discharges to the Pacific Ocean at Kingscliff (~ 1.15kms north).

5.2 Local Geology & Soils

DPI (2004) identifies the study area as part of the (Qhbd) Holocene Coastal Barrier, which has been extensively disturbed by past heavy mineral sand mining operations. Adjoining geological units include the Holocene Sandy Beach (Qhbb) to the immediate east and the Holocene Estuarine Channel (Qhec) (i.e. Cudgen Creek).

Morand (1996) identifies the study area primarily as the aeolian landscape *Bogangar* (**bg**) with estuarine influences from Cudgen Creek (i.e. mixed estuarine and aeolian materials) described as *Cobaki "a"* (**cba**). The dominant soil units of the study area are disturbed Podzols (Uc2) and Siliceous Sands (Uc1.21). Roy (1975) states that the meandering path of Cudgen Creek indicates that it (Cudgen Creek) traverses *deeper* sands (than those of Cudgera and Mooball Creeks) and is therefore free to meander.

5.3 Hydrogeology

Regional groundwater flow is considered to flow towards the west and /or north-west of the study area in a general direction toward Cudgen Creek with tidal influences of the nearby Pacific Ocean also affecting groundwater flows and local groundwater heights.

A search of existing licensed groundwater bores within 1.5 km radius of the study area was conducted using the NSW Natural Resource Atlas (NRATLAS) website (<http://test.nratlas.nsw.gov.au/wmc/savedapps/nratlas>) on the 14 May 2008. Nine (9) licensed groundwater bores were identified within the 1.5 km search area of the site boundary. The location of all identified licensed groundwater bores are plotted on Fig. 4 (Appendix 1).

Cardno MBK (2002) conducted groundwater monitoring on the adjacent SALT site between 16th October 2000 and 16th January 2002, and recorded depths to groundwater as ranging from 0.9 – 12.2m (it is assumed this measurement is taken from the top of the groundwater bore casing). The locations of the groundwater bores are not included in the Cardno MBK report, so the direction of groundwater flow is uncertain.

The closest bore identified by the NRATLAS search was approximately 520 m to the west of the western boundary (GW065298) of the study area, which has a recorded standing water level (SWL) of 7.0 metres below ground level (mbgl) (refer Appendix 2). Profile data supplied by bore installers describes a clay substrate (0-6 mbgl) overlying weathered basalt (6-13 mbgl). The majority of bores were sunk to depths not exceeding 54 mbgl, and used for domestic or irrigation water supply. Copies of the groundwater bore installation details are provided in Appendix 2.

A groundwater investigation was not conducted as part of this investigation.

6.0 Site Land Use & Historical Review

6.1 EPA Register Searches

A search of the current list of licensed activities as per Schedule 1 of the Protection of the Environment Operations Act 1997 (<http://www.environment.nsw.gov.au/prpoeo/licences.htm>) did not identify any licensed polluting activities occurring on or within a 1.5km radius of the subject site.

A search of the Contaminated Land Record (<http://www.environment.nsw.gov.au/clmapp/searchregister.aspx>) identified no notices regarding the subject site or surrounding properties.

6.2 State Government Information

6.2.1 Department of Lands

Anecdotal information provided by staff from Department of Lands (DoL) during a telephone conversation held on 1st May 2008 indicates the following:

- The Department of Mines (now known as Minerals & Petroleum within the NSW Department of Primary Industries) was responsible for the site during the period of sand mining;
- The Cudgen Creek may have been backfilled using residual mining materials;
- The Department of Health conducted a radiation survey on site during the 1980's which detected some radioactivity readings above background concentrations in the western section of site;
- Stockpiled spoil heaps containing illmenite and monazite sands were observed during a site inspection conducted in July of 1983 involving Dept. of Mines, Tweed Shire Council (TSC), Dept. of Health and Currumbin Minerals (the mining company operating on site).

Information provided by the Department of Primary Industries (DPI 2004) indicates:

- An 8km stretch of mineral sand mining path exists throughout the coast, extending 800 m to the north of site and 7 km to the south (Fig. 9; Appendix 1);
- The sand mining path existing across the site and surrounding area was mined for mineral sands during 1943 to 1975, however the exact dates relating to the site specific mining is unavailable;
- Extracted material was not shown to have been processed and tailings were not shown to have been deposited on site; and
- Various mining companies were involved in mineral sand mining throughout the Cudgen Creek area including: NSW Rutile Mining Company (1943 - 1975), Cudgen R Z Ltd (1949 - 1962). It is not clear which company mined onsite.

6.2.2 Department of Health

Conversations with staff from NSW Health on 1st May 2008 provided additional anecdotal information that suggests clean up works were undertaken (upon lands to the south although this has not been clarified nor confirmed) by the NSW Environment Protection Authority (EPA) Radiation Services Branch and Unhealthy Buildings Branch (EPA now part of NSW Department of Environment & Climate Change (DECC)) and Tweed Shire Council.

6.2.3 Department of Primary Industries

Five (5) mining lease (ML) documents relating to on site mining activities were obtained from Department of Primary Industries (DPI) Minerals and Petroleum Branch. Mining leases were issued by the Department of Mines (now DPI) to applicant companies to enable mining of minerals at specified locations. A copy of the mining lease documents are included in Appendix 3.

A Mine Inspectors Report detailing mining activities within the Cudgen Creek area obtained from DPI Minerals online library is summarised in Table 2 below. Mining leases that pertain to the study area are ML 15, ML24, ML46, GL11 and GL18 which are provided as Appendix 3.

6.3 Local Government Records Searchers

A was undertaken by Tweed Shire Council (TSC). TSC have indicated that the land has been subject to historical sand mining activities, which is considered a potentially contaminating activity (TSC 2008). A copy of the Contaminated Land Information Council Records Search from TSC is included as Appendix 4.

6.4 Previous Reporting

6.4.1 Detailed Site Radiation Investigation Report & Remediation Action Plan SALT, South Kingscliff – Cardno MBK, August 2002

Cardno MBK (2002) prepared a site contamination assessment of the adjoining SALT site, which detailed the site history and an investigation of residual radioactive material with respect to the mineral sand mining activities conducted within the area. This report can be summarised as follows:

- Mineral sands were excavated by hydraulic dredge during heavy mineral sand mining activities, partially processed on site and then transported off site for further separation. Residual material was then pumped back into the dredge pits and used as backfill material;
- The extracted mineral sands contained minor quantities of a cream coloured sand identified as Monazite, a material which, when occurring in significant volume, can exhibit radioactivity levels above normal background levels (Cardno MBK 2002);
- Anecdotal information indicated that the south western portion of the SALT site was used for mineral processing which is supported by aerial photography;

Table 2. Summary of Mining Activities

Date	Relevant Mining Lease	Mining Activities Undertaken	Comments
October 1970	ML46, ML24 SALT Site PML22	Dredging commences in ML24.	N / A
January 1971	ML46 & ML24 SALT Site ML22	Large area of reshaped tailings has been covered with topsoil.	It is not clear which site the tailings covering activities occur on.
February 1971	ML46, ML24 SALT Site ML22	Tweed Shire Council issues mining operator with complaint stating retaining wall along edge of Cudgen Creek restricts water flow.	N / A
March 1971	ML46, ML24 & GL11	Subsequent removal of retaining wall after receipt of Council complaint, results in tidal flow of sand into a dredge pond onsite. This continues through to April.	It is not clear when tidal sand flow onto site ceases.
August 1971	GL18, GL11 & ML24	Tailings spread over ground surface and covered with topsoil to prevent wind erosion into Cudgen Creek. Discharge water from operation released into Cudgen Creek is kept under surveillance by mining company and no complaints received.	The only prior mention of complaints regarding discharge water is detailed in notes in September 1970 where a complaint was received regarding pollution of the Cudgen Creek. The notes state the complaint was investigated and found to be 'groundless'.
June 1972	ML46, GL11, ML15 & ML24	Dredging has reached the boundary of site and is progressing into the adjacent SALT site.	N / A
June 1975	ML46 SALT Site ML32	Reshaping and rehabilitation of area almost completed.	N / A

Sources: Mine Inspectors Report 1970-1981.

- The south western portion of site was investigated for radioactivity, and radioactive materials were detected in excess of NSW Department of Health – Radiation Branch action level thresholds for dwellings, schools, businesses and factories (2002);
- Radioactive materials was found to be buried at depths up to 5m below surface level on the south western portion of the SALT site, encompassing a total area of approximately 68, 000 m.
- A remediation action plan is included in the report to prepare the site for its future land use.

It is acknowledged that the Cardno MBK investigation focused on the south western portion of the SALT site. Aerial photography from 1972 (refer Fig. 7) indicates the location of two open cut pits on the northern portions of the SALT site that were not investigated in the Cardno MBK 2002 investigation. Namely, an open cut pit located in the north eastern portion of the SALT site; and the pit on the south western section of Lot 490 encroaches over the SALT site boundary. It is unclear from the 2002 investigation why these areas were not assessed for tailings deposits.

Validation information pertaining to the remediation of radioactive areas on the SALT site identified in the Cardno MBK report (2002) was not reviewed as part of this investigation. Therefore, LandPartners can only assume that these areas have been deemed to not pose an ongoing Significant Risk of Harm (SRoH) to residents as the site has been developed for residential land uses.

6.4.2 Site Radiation Report – Lot 490, Casuarina Way, Kingscliff, 2005

Cardno MBK undertook a site radiation assessment on the proposed residential development areas on Lot 490 during January and July of 2005. The site history outlined within this report was an extension of the information collected for the SALT report discussed above (i.e. Cardno MBK 2002). A summary of the 2005 report is as follows:

- A sand dredge was operated onsite for backfilling purposes, using sand recovered from Cudgen Creek;
- Mineral sands were excavated by hydraulic dredge, partially processed on site then transported offsite for further separation, and residual material was pumped back into the dredge pits on the adjacent SALT site for use as backfill material;
- Interview with former site workers indicated that sand was stockpiled onsite but not processed, and that it was ‘unlikely for radioactive sands to be present on the subject site’;

- Radiation levels detected (during the investigation) on the proposed residential areas (within Lot 490) did not exceed NSW Department of Health – Radiation Branch action level thresholds for dwellings, schools, businesses and factories (2002); and
- An additional assessment of the unassessed areas would be required on the entire Lot on which development is proposed.

6.5 Surrounding Land Use & Environment

6.5.1 1940's – 1980

Historical imagery obtained circa 1947 indicates that land south of Cudgen Creek is predominantly covered in mangroves and similar estuarine/freshwater swamp vegetation, and coastal bushland to the east (refer Fig. 5). To the north of site some residential development is evident (i.e. in the township of Kingscliff), along with agricultural pursuits to the immediate west and further.

As discussed in Section 6.1, a large mineral sand mining path transacted much of the Kingscliff coast with mining for heavy minerals and construction sands occurring during the period between 1943 and 1975 (DPI 2004). Cardno MBK (2002) reported that mining on the adjacent SALT site (to the south) occurred during the period between 1954 and 1976. Historical aerial imagery collected for the Cardno MBK investigation (i.e. 1962 (refer Fig. 6) and 1972 (refer Fig. 7) and again by LandPartners (i.e. current investigation) confirms this conclusion.

Information provided by DPI (2004) indicates that extracted materials were processed at two processing plants located 500 m to the north of site and 775 m to the south on the adjacent development as shown on Fig. 9 (Appendix 1).

The circa 1972 historical aerial image suggests that mining activities along Cudgen Headland have concluded with rehabilitation works underway, namely: backfilling of the open cut, re-establishment of coastal vegetation and removal of the processing plant (refer Fig. 7). Residential expansion inland (west) of Cudgen Headland and ongoing agricultural activity to the west of site (and the township of Kingscliff is apparent during the period between 1962 and 1972. Mining activities upon the SALT site extended in all directions since 1962 (refer Fig. 6).

Two former construction sand quarries exist are located within the local vicinity, approximately 400 m north of the study area and 1.3 km south west respectively. The latter quarry was in operation between 1979 and 1982 (as listed by DPI 2004).

6.5.1 1981 - Current

The circa 1987 historical aerial image (refer Fig. 8) shows that sand mining to the north and south of study area has ceased, and that extensive regeneration of coastal vegetation and backfilling has occurred since 1972. Agricultural activity is still dominant to the west of Cudgen Creek as shown in the 1987 image, as well as further residential expansion north of Kingscliff (Figure 6).

The 2004 aerial image as shown in Fig. 2 indicates that the SALT site to the south of study area is under construction, with some roads having been paved or under construction. The majority of the ground surface has been levelled for the formation of suitable building platforms for current and future residential development.

A summary of the current conditions of the surrounding land within a 1.5 km radius is provided in Table 3 below.

Table 3. Current Surrounding Land Uses

Direction	Description
North	• Cudgen Headland – recreational area and beach; • Residential area of Kingscliff; and • Kingscliff Primary School.
South	• SALT and Casuarina Beach Residential developments.
East	• Crown Land Lots 489 (DP47021) and 500 (DP 1095235) designated as Public Recreation and Coastal Environmental Protection; and • Pacific Ocean.
West	• Cudgen Creek; • Residential properties; and • Kingscliff High School.

6.6 Site History

6.6.1 1940's – 1980

Historical imagery of the study area from circa 1947 indicates that the site was covered in mangrove and swamp vegetation along the western portion with coastal bushland along the eastern portion of the study area. Cudgen Creek meanders through the centre and western portion of site (Fig. 5; Appendix 1).

A small area of mined land is evident in the circa 1962 image on the most south westerly point of the site (Fig. 6; Appendix 1). The 1962 image shows that the shape of Cudgen Creek has been significantly altered, with substantial backfilling activities evident. The vegetation cover has significantly changed (i.e. as a result of removal and mining activities) along the eastern section of site. Extensive clearing of vegetation on the site boundary indicates the adjacent properties have most likely been cleared for the facilitation of mining. Extensive clearing for mining activities is evident in October of 1972 over the majority of study area (Fig. 7; Appendix 1).

The 1972 historical aerial image shows a large working face was operating in the south-west corner of the study area, which appears to be inundated (as indicated by the darker shaded section). This pit contains a lighter shaded area which suggests two things: the pit has been backfilled with the unusable portions of mining materials; and or the pit contains a shallower cutting face in the centre (refer Fig. 7). This pit was most likely used as a water supply dam for mining operations, and machinery observable in the furthest northern corner implies the use of a hydraulic dredge to pump residual materials to be used as backfill, or a water supply pump. What appears to be a drainage line is located east of the pit, and drains onto the adjacent property to the south.

6.6.2 1981 - Current

The circa 1987 historical aerial image (Fig. 8; Appendix 1) shows that sand mining on Lot 490 has ceased and the site has subsequently been rehabilitated, with open cut pits backfilled. The study area was covered in patchy revegetation with coastal shrubs and bushland. Cudgen Creek has been dredged and reshaped again along the far northern boundary (refer Fig. 8).

The circa 2004 historical aerial image as shown in Fig. 2 indicates that vegetation on site is fully established with no significant bare (i.e. wholly un-vegetated) portions visible.

7. Site Inspection

A site inspection was conducted over the period of the 7th to 10th May 2008 to visually assess and identify any potential indicators of contamination present within Lot 490. Indicators of potential contamination and the observations recorded during the inspection are listed below in Table 4.

Table 4 Site Inspection Observations

Inspection for	Observations
Areas of discoloured soil, polluted water, significant odours, and affected plant growth	None observed.
The presence of stockpiled material, imported soil or fill material	A large mounded area was observed in the south western portion of site, extending from 70 m east of the boundary with Cudgen Creek in the southwest corner to Casuarina Way. The Cudgen Creek end of the mound possesses a sharp incline (25 - 30%) and was approximately 8m AHD. As the mound extends across to Casuarina Way, the incline gradually decreases (1 - 5%). The mound consisted predominantly of sand, with approximately 10% shell material (refer Plate 1). The presence of shell material suggests the material was dredged from estuarine or marine sources (i.e. Cudgen Creek).
Location of all visible features including foundations, tanks, pits, wells and bores	No visible structures were observed on site as the area is currently undeveloped.
Chemical storage and transfer areas, including the presence of waste or chemical containers	Solid inert waste was littered across the site. Waste included wooden furniture, bicycles, plastic bags and children's toys, mattresses, glass bottles, aluminium cans, car tyres, foam, paper and discarded electrical appliances. No evidence of chemical storage was observed.
The direction of surface water runoff from the site	Surface runoff is expected to be minimal given the free-draining podzolic soils of the study area.
Adjacent landuse	West – Cudgen Creek and residential properties. East – South Pacific Ocean. North – Cudgen Creek and bridge crossing (Kingscliff). South – SALT residential estate.
Any differences between existing conditions and the information obtained during the site history review	The site land use has shifted from mineral sands mining to re-vegetated, vacant land usage surrounded by residential land developments.

The site appears to be revegetated mainly by exotic species such as Bitou Bush and Lantana with much of the site impassable due to the lack of proper weed management and control. Sparsely dispersed stands of Casuarina and Banksia species are present amongst the exotics, particularly upon the extreme low lying areas to the south-west and the elevated sections of the north and north-east (bounding Casuarina Way).



Plate 1. Shell grit observed across the majority of the study area

8. Identified Areas of Environmental Concern

The preliminary site history review has identified the portions of the study area that have been subjected to historically mineral sand mining activities as Areas of Environmental Concern (AEC). These AEC are considered to be sources of potential Contaminants of Concern (CoC). The site history review and subsequent site inspection failed to identify any other activities (such as those listed in Schedule 1 of NRRC 2007) that may have also provided a potential contaminating legacy upon the study area. Fig. 9 (Appendix 1) illustrates the extent of the identified AEC across the study area and surrounding environment.

8.1 Mineral Sands Mining Activities

The processing of mineral sands and tailings deposition from mineral sand mining activities is a potential source of radionuclide contamination. Radionuclide materials emit ionizing radiation, which at low doses is considered a risk to human health (ARPANSA 2002). Waste from mining and milling activities contains only low concentrations of radioactive material but it is generated in large volumes in comparison with waste from other facilities.

Although mining and milling waste contains only naturally occurring radionuclides, these radionuclides cannot be considered to be in their original states or concentrations, since their physical and chemical forms may have been altered substantially, and exposures may be influenced by the operation of the waste management facilities (IAEA 2002).

Historical aerial photography (refer Figs. 5 – 8) and DPI data (DPI 2004) do not positively indicate that processing of mineral sands and deposition of product tailings has historically occurred on site. However, given the anecdotal information obtained from State Government Departments during the site history and land use investigation, it is acknowledged that the potential for these activities to have occurred within the south western portion of site exists.

A comparison of the location of the cut face pit (as shown in Fig. 7) with the current contour information indicates that the elevated mound area sits immediately adjacent (north-east) of the cut pit. It is inferred that the mounded section has resulted from the active removal of sands (for either construction and/or mineral extraction purposes and the replacement of unwanted or unused fractions), forming the elevated mound still present today.

8.2 Identified Potential Contaminants of Concern

The CoC associated with the identified AEC on site are outlined in Table 4 (below).

Table 4. Potential Contaminants of Concern from Onsite Sources

Contaminant Source	Potential Contaminants
Mineral Sands Mining – Processing & Tailings Deposition ¹	Ores (ilmenite and monazite) containing naturally occurring radionuclide materials (NORM)

Notes:

¹ Mineral Sands Mining – ARPANSA 2005

9. Adopted Site Assessment Criteria

9.1 Radiation Investigation Levels

The dominant form of radiation from low-level radioactive wastes originating from processed mineral sands is gamma radiation which is measured in units of $\mu\text{Gy/hr}$ (micro-Grays per hour) or $\mu\text{Sv/hr}$ (micro-Seiverts per hour)¹. The NSW Department of Health Radiation Branch has developed action level thresholds for the clean up and disposal of radioactive residues from mineral sands operations (NHMRC 1992), which are presented in the Table 5 below.

Table 5. Action Level Criteria

Type of Development (end use)	Occupancy Levels	Remedial Action (Trigger) Level
Dwellings, schools and playgrounds, businesses and factories	Regularly (day to day basis)	0.7 $\mu\text{Gy/hr}$ for all points at 1 m above the area of concern
Gardens and other areas	A few hours per week by the same or differing individuals	1.0 $\mu\text{Gy/hr}$ for all points at 1 m above the lowest surface of the area
Roads, paths and other areas	Intermittent occupation	2.5 $\mu\text{Gy/hr}$ for all points at 1 m above the lowest surface of the area

NOTE: All values quoted should include a value for normal natural background levels of 0.1 $\mu\text{Gy/hr}$.

The lowest action criteria (i.e. 0.7 $\mu\text{Gy/hr}$) has been adopted as a trigger for further investigation in order to ascertain the potential SROH to future occupants of the proposed development.

¹ Please note that 1 Seivert (Sv) equals 1 Gray (Gy)

10. Preliminary Site Assessment

LandPartners has conducted a preliminary site assessment including a complementary surface radiation survey. This assessment has been conducted in order to characterise the likelihood of site contamination within the identified AEC. Available reporting and monitoring information has been provided by the client and relevant State and Local authorities (NSW Health, NSW Department of Primary Industries and NSW Department of Land).

10.1 Site Radiation Survey

10.1.1 Radiation Survey Methodology

Both aerial photography and DPI data (2004) do not identify processing or deposition of mineral sands as having historically occurred on site. Nevertheless, in accordance with the recommendations of the Cardno MBK (2005) report, to determine the potential for any inherent health risk to residents a surface radiation survey has been conducted to complement the extent of the Cardno MBK (2005) survey. LandPartners has undertaken a site radiation survey of the proposed development area, including recreational (creek-side pathways; refer Fig. 3) and environmental areas (rehabilitated coastal vegetation; refer Fig. 2). A 10 m x 10 m grid was established on the western and northern portion of site *that was not included* in the Cardno MBK (2002) radiation investigation (Fig. 10; Appendix 1). In the event that elevated readings were detected, a smaller 5 m x 5 m grid was assessed on the area recording elevated readings in order to provide greater characterisation of any potential “hotspot” areas.

The survey was conducted using a hand held Rotem RAM Gene Meter, taking radiation measurements at 1 m above ground surface level (known as near surface radiation) and at ground level (surface radiation). The radiation equipment is considered capable of assessing the shallow soil layer to a maximum depth of 250 mm below ground level (bgl).

As discussed in the Cardno MBK (2005) report, the radiation measurement methodology provides coverage over an area of approximately 8m in radius, with 90% of the measured exposure originating from the top 250mm of soil materials. Weather conditions were fine with soil moisture conditions assessed as dry with no surface pooling or waterlogging observed during the site radiation survey. A natural background surface gamma radiation level of 0.1µGy/hr is considered as appropriate for the area.

10.1.2 Site Radiation Survey Results

A total of 606 radiation points were examined over the period 7th to 10th May 2008 over the area shown on Fig. 10. The results of the surface radiation survey are provided in Appendix 5.

Surface radioactivity measurements range from 0.01 to 0.22 $\mu\text{Gy/hr}$ whilst near surface radioactivity measurements range from 0.01 to 0.18 $\mu\text{Gy/hr}$. Average surface and near surface radioactivity measurements were 0.1 and 0.09 $\mu\text{Gy/hr}$ respectively. The overall range of measurements was between 0.01 and 0.27 $\mu\text{Gy/hr}$.

The results of the complementary radiation survey of Lot 490 do not exceed the action triggers of the adopted site assessment criteria (as shown in Table 5), and are therefore not considered a significant risk to human health. On this basis, it is unlikely that mineral sands mining tailings were deposited within the 250 mm of the ground surface within the areas of investigation. Please note that as no indication of surface radiation levels in excess of the adopted site assessment criteria were found, the need for additional radiation survey (at a smaller grid; e.g. 5 x 5 m) or subsurface investigations was triggered. Based on the current development layout and proposed land use regime (as depicted in Fig. 3), no subsurface investigation are considered appropriate at this stage.

It is acknowledged that significant dense vegetation cover was encountered across Lot 490 during the radiation survey, which prevented access to certain areas on site to take radiation level readings. Historical images of the study area (refer Figs. 5 - 8) and anecdotal information suggests that tailings were deposited on site and mineral sands were stockpiled onsite; however, confirmation of this information was not obtained prior to the conclusion of this report. In contrast, DPI data (2004) does not suggest that tailings or stockpiles containing radioactive minerals were deposited on site, and indicate that mineral sands were processed in concentrating plants 500 m to the north of site and 800 m south of site (refer Fig. 9).

Therefore, following the findings of the site radiation survey, it is believed that the likelihood of a persistent contamination legacy resulting from historical mineral sands mining to represent a SRoH to end users is considered to be highly unlikely.

11. Recommendations

Although 10 x 10 m coverage was not obtained in all sections of the complementary survey area (due to dense vegetation cover), the extent of the surface radiation survey is considered appropriate and accurate. The need for further surface survey work is not justified at this stage.

Given the findings of the site radiation survey(s) (Cardno MBK 2005 and LandPartners 2008), the requirement for additional radiation investigations is dependent upon the following:

- The potential for substantial excavation within the south-western section of the study area (particularly the area described as the elevated mound).

Should excavation of soil materials within this section of the study be proposed, initial subsurface radiation investigations should be conducted in order to provide an appropriate level of characterisation with regard to potential radiation contamination (at depths exceeding 250 mm bgl). Such investigations are to be conducted by suitable trained and experienced personnel familiar with the undertaking of subsurface radiation investigations.

12.0 Conclusion

In order to assess the suitability of the site for its proposed development and the associated end land use, a Preliminary Contaminated Site Investigation was undertaken to identify any past or present activities that had occurred (or are currently occurring) within Lot 490 that may have contributed to potential land (and water) contamination.

A site inspection, desktop historical and current land use review and a radiation survey were carried out in order to provide an appropriate and accurate characterisation of the site. The site history and land use of Lot 490 has identified the following AEC:

- Historical heavy mineral sand mining activities occurred on site; however, no evidence of mineral processing or tailings disposal was positively identified during this investigation. The presence of such activities (i.e. processing and tailings disposal) has the potential to allow the accumulation and concentration of naturally-occurring radionuclides.

Unconfirmed anecdotal information indicated that extraction and filling activities had occurred within the south-western section of the study area; however, this information has not been validated at the time of reporting.

DPI (2004) data identified the presence of processing plants within adjoining lands (e.g. SALT development to the south of Lot 490). No definitive indications of the presence of tailings and/or processing plants upon the study area were found during this investigation with filling activities typically associated with re-soiling and reshaping works. Some filling of former dredge paths occurred as a part of natural tidal movement following a request from Tweed Shore Council in April 1971.

Therefore, as a result of the site history and land use review, the potential for CoC associated with heavy mineral sand mining to be present on site in concentrations representing a SROH to end users was found to be significant. As a result of site radiation survey was conducted (to complement previous investigations) across the western sections of the study area.

No radiological values were measured in excess of the adopted site assessment criteria (refer s. 9.1) during the radiation survey conducted upon Lot 490. Based on these findings, the likelihood of a persistent contamination legacy resulting from historical mineral sands mining to represent a SROH to end users is considered to be highly unlikely.

Nevertheless, this report and the investigations undertaken as a part of it have been conducted in accordance with the proposed development layout and design provided by LPPL. As a result, no requirement for subsurface investigations was identified during the preparation of this report. Should any substantial excavations be proposed within the south-western section of the study area, initial radiation investigations, including subsurface measurements are recommended to provide an appropriate safeguard to unearthing and redistributing potentially radioactive materials currently interred and undetected.

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