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Mr Roman Wereszczynski
Manager Health, Building & Regulatory Services
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219204.00
10 February 2023
P.001.Rev2
PMM / JMN:gl

Attn: Mr Roman Wereszczynski

Email: Roman.Wereszczynski@randwick.nsw.gov.au

Dear Sir

Peer Review of Detailed Site Investigation – Randwick Barracks 373A Avoca Street, Randwick, NSW

1. Introduction

Douglas Partners Pty Ltd (DP) has prepared this Peer Review Report following acceptance of DP's proposal dated 8 November 2022 by Randwick City Council (RCC) in their correspondence from Oscar Guillen, dated 18 November 2022 and subsequently a further proposal dated 16 December 2022 and further instructions dated 5 January 2023.

The peer review is based on the information provided, i.e., the report entitled Draft [Detailed Site Investigation] DSI Randwick Barracks 373A Avoca Street, Randwick, NSW prepared for Defence Housing Australia (SLR ref: 610.30041-R01 Version No: -v1.3) dated February 2021 (SLR Consulting, 2021) [the DSI]. The report was provided in pdf format and comprised a total of 7933 pages, including 98 pages of text plus drawings and other appendices e.g., bore logs, laboratory certificates, site history details etc.

Additional information comprising site audit statements, (CH2MHILL, 2003) (CH2MHILL, 2008) and an environmental management plan (EMP) (GHD, 2008) was also provided as background information by RCC on 24 November 2022 These documents relate to adjoining sites.

The purpose of the peer review is to determine the overall suitability of the above DSI report.

The peer review should not be construed as an audit as defined in the Contaminated Land Management Act and in this regard, we understand that a NSW EPA accredited auditor has been appointed by Defence.

2. Background

The subject site is located at 373A Avoca Street, Randwick, NSW and comprises the eastern portion of Randwick Barracks, adjoining Bundock Street, Randwick, NSW (the site). The site and relevant site features are shown on Figure 1 and Figure 2, Appendix A of the referenced report. The site occupies an area of approximately 19.5 ha.

Defence Housing Australia commissioned SLR Consulting Australia Pty Ltd (SLR) to undertake a DSI following on from a previous Preliminary Site Investigation (PSI) prepared by Jacobs, entitled 'Randwick Barracks Preliminary Site Investigation', dated 2020.

The PSI was not provided for review but noted that '…*the site had a range of historical land uses including as a Naval Stores Depot (with previously demolished Naval Store buildings), Rifle Range, Grenade Bursting Range and Army Transport Compound. Currently the southern portion of the site remains active as Defence offices with associated carparking, an overflow carpark and a storage yard, whilst the remainder and majority of the site is vacant. Some remnant infrastructure and buildings are present, with approximately 70% vegetation across the site. The PSI identified 17 Areas of Environmental Concern (AEC) which may present the potential for soil, groundwater and/or soil vapour contamination. Fifteen AEC were onsite, while there was an additional two identified offsite*...'.

The AEC (17 in total) were listed in the SLR report at Table 5-5 and are shown on drawings included in the report. It is noted that AEC 16 and AEC 17 are listed by SLR as being off site (Randwick Zone Substation and Former Launderette) and are to the north of the site boundary. Examination of Figure 3-1 also suggests that AEC 10 (Oil Water Separators) is off site (or partially off-site) to the west of the site boundary.

Additional areas which partially extend outside the site boundary include AEC 1 debris and fill material demolition - (note - there appear to be 2 boundaries for AEC1 - this may represent 2 sources of information or may need to be corrected on the drawing; AEC2 former pesticide use; AEC3 formal rifle range (which covers a much larger portion of land including the subject site) and AEC12 (formal metal treatment works). In addition, the boundary of AEC12 does not appear to include the full extent of the wash bay shown on Drawing 2. A yellow boundary is shown around a property to the adjacent to the southeast corner of the site and below AEC10 (former Stop Butt) however this is not labelled on Drawing 2.

A quick review of google maps also reveals petrol stations located to the north west of the site on the corner of Avoca and Rainbow streets and to the southwest of the site on the corner of Anzac Parade and Snape Streets. DP considers a Lotsearch report (or similar) may be useful and should be undertaken for the site in case of additional areas of concern, including off site sources (especially for historical sources) not already included in this DSI.

3. Scope of Peer Review

The scope of work and objectives of the peer review are as follows:

- The suitability of the DSI report in terms of the scope of investigations undertaken, including the investigation of soil, water, groundwater, soil gas and asbestos contamination;

- The suitability of the DSI report to address the potential for and identification of other forms of contamination on the site including ordnance and per- and poly-fluoroalkyl substances (PFAS) compounds;
- The suitability of the DSI report to address the potential for off-site migration of contaminants and any potential 'health-risk impacts' on the public, in areas in close proximity to the site, including Randwick Environmental Park / Community Centre;
- The DSI's general compliance with published guidance made or endorsed under regulation including *inter alia:*
    - NEPC *National Environment Protection (Assessment of Site Contamination) Measure* 1999 (as amended 2013) [NEPM] (NEPC, 2013);
    - NSW *EPA Guidelines for Consultants Reporting on Contaminated Land, 2020* (NSW EPA, 2020); (NSW EPA, 2020);
    - NSW EPA *Sampling Design Guidelines Part 1 Application and Part 2 Interpretation* (NSW EPA 2022);
    - NSW EPA, *Waste Classification Guidelines*, 2014 (NSW EPA, 2014) and NSW EPA, *The excavated natural material order 2014; and*
    - NSW EPA, *Addendum to the Waste Classification Guidelines (2014) - Part 1: classifying waste,* 2016.
- The accuracy and practicality of the advice provided in the DSI based on relevant guidelines;
- The validity of the conclusions in the DSI based on the works undertaken; and
- The suitability of recommendations for future investigation work and / or remediation work outlined in the DSI.

The objective of the review is to prepare a peer review letter report based on the DSI (SLR Consulting, 2021). The review is broadly based on the requirements for DSI's set out in NSW EPA, 2020.

Three additional documents were supplied by RCC as follows, but which do not comprise part of the review scope, but include useful background information, these are as follows:

I. Site audit statement and site audit report by James Davis of CH2MHILL, dated 26 February 2008 in respect of Lots 16 and 17 in DP 1042814 (The Randwick Environmental Park), which indicated that the 13.2 ha site was suitable for open space and recreational land use; and

II. Site audit statement and site audit report by Ross McFarland of CH2MHILL, dated 23 September 2003 which concluded that land defined (by Randwick Council) as within 33 to 149 Bundock Street and 373A, Avoca Street, Kingsford was suitable for a range of sensitive land uses including residential, schools and recreational open space; and Environmental Management Plan (EMP) by GHD, dated February 2008 in respect of the Randwick Environmental Park [Note: the EMP concerns the management of asbestos which remains on the site and indicates that:

'…*This EMP has been designed to address the potential hazards relating to bonded asbestos fragments in soil on the site and provide a risk management strategy to minimise the risk of exposure to respirable asbestos airborne fibres for workers undertaking bush restoration or intrusive works*…'].

These documents refer to the land to the north and east of the subject site which was previously DoD property, and which has since been remediated and validated, but is now owned and operated by RCC as a park facility.

4. Review of the DSI

4.1 Review Background

Review of the DSI has been undertaken using predominantly Table 2.3 of NSW EPA, 2020 (see above).

Table 1 below shows the information which requires to be included in a DSI and provides related commentary on any observed deficiencies or shortcomings of the DSI in relation to the checklist. In this regard it is noted that the DSI as supplied (now) comprised the entire document rather than an abridged version (as previously reviewed under an earlier version (Rev0) of this report dated 7 December 2022 and which was the subject of the previous report).

Table 1 - Detailed Site Investigation Checklist (adapted from Table 2.3 of NSW EPA, 2020)

Report Section	Required Information	Included / Not Included	Commentary
Document control	Date, version number, author and reviewer (including certification details) and who commissioned the report	✓	The document control section of the report indicated that 5 versions of the report has been issued. The current (draft) 5th version which is the subject of this review was identified as SLR ref: 610.30041-R01 Version No: -v1.3, dated February 2021. In addition, part of the document control panel was redacted. It is noted that the report is watermarked draft and will need to be finalised and watermarks removed in order to be a verified and issued final report. A final version will likely be required by the appointed site auditor. The document control section does not identify the author(s) of the report, or the reviewer, nor what their certification details are. In this regard it is assumed that NSW EPA (2020) is referring to specialist certification in site contamination by CEnvP (CEnvP-SC) or similar.

Report Section	Required Information	Included / Not Included	Commentary
Executive summary	Background, Scope of work. Where appropriate, a summary of key findings, observations and sampling results (if available). Summary of conclusions and recommendations	✓	The ES is quite comprehensive although the summary of results does not include actual concentrations of contaminants, but simply that they did or did not exceed the adopted comparative criteria for the current or proposed land uses. Inclusion of the results or a range of concentrations/ guideline criteria would be useful for inclusion in the ES. The ES refers to 17 areas of environmental concern (AEC) which were identified in the previous PSI by Jacobs. The ES implies that the site investigation (SI) works undertaken by SLR for the DSI were based on these AEC and on a sampling analysis and quality plan (SAQP) also prepared by Jacobs (2020). Neither the PSI nor SAQP were examined as part of this review. The DSI appears to rely heavily on the AEC identified by Jacobs and provides limited commentary as to whether these are fully comprehensive (notwithstanding the DSI provides a sampling grid across the site which comprised both a tight grid as well as focussed sampling of the identified AEC).
Objectives	The objectives of the investigation/report and the broader objectives for the site / investigation	✓	The objectives of the DSI were clearly set out. The ultimate objective was to determine the suitability of the site for future redevelopment and use as residential and open space.
Scope of work	Scope of work performed (work not undertaken where relevant)	✓	The scope of work was set out to a level of detail which is consistent with a typical DSI which meets published requirements. As noted above the scope was based on the PSI and SAQP which were not reviewed and therefore the

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			adequacy of the sampling design in terms of identifying all possible AEC on the site as well as providing sufficient sampling density in terms of random grids and stratified (focussed) sampling cannot be fully determined, although as noted above the sampling grid adopted across the site in the DSI comprised both a tight grid as well as focussed sampling of the identified AEC. Overall, the scope appears to be satisfactory. The contingency (measure) for future unexpected finds as proposed in the DSI is considered appropriate.
Site identification	Site identification and detail items from ASC NEPM Field Checklist 'Site information' sheet.	✓	The site was adequately identified from a locational and ownership perspective.
Site history	Site history items from ASC NEPM Field Checklist 'Site information' sheet. A summary is enough if detailed information was included in an available referenced previous report.	✓	Site history is summarised, and reference made to the PSI and SAQP which were not provided for review. It would have been useful for the reviewer to be provided with analytical results from any historical testing at the site.
Site condition and surrounding environment	Site condition and surrounding environment items from ASC NEPM Field Checklist 'Site information' sheet.	✓	The DSI noted that at the time of inspection and investigation, the central and northern portion of the site comprised open space with concrete slabs and vegetation, whilst the southern portion of the site was an operational facility occupied by the Department of Defence. The location of concrete slabs and buildings is clearly shown on Figure 2 of the DSI. Land uses surrounding the site included low density residential properties to the north and south, the remainder of Randwick

Report Section	Required Information	Included / Not Included	Commentary
			Barracks to the west, with Munda Street Reserve and Randwick Environment Park and Wetlands to the east. In Section 5.3.5 SLR provides a statement *that groundwater is expected to flow from the northern portion of the site to the South-East, before flowing towards the south-west from the central portion of the site.* More information is needed to determine local groundwater flow direction at the site (especially in relation to the possible impacts on the Randwick Environment Park). The DSI reported the widespread presence of bonded asbestos containing materials (ACMs) and building demolition wastes across the site, as well as fill materials, fuel storage, metal treatment works and storage of small quantities of chemicals, attributed to the historical activities on site. The site formed part of the Randwick Rifle Range from 1891 until 1924, when the rifle range was closed and used as a small arms school until 1942. The Randwick Naval Stores Depot was constructed in 1943 and consisted of 26 main stores / buildings which stored machinery and dry goods. The stores are understood to have been constructed of timber and asbestos cement cladding, with the stores progressively demolished between 1986 and 2009.
Sampling and analysis quality plan and sampling methodology	A summary is enough if detailed information was included in an available referenced previous report, to be updated with site-specific information. See Table 2.2	✓ ×	Summary provided. However, the prior PSI and SAQP by Jacobs (2020) were not reviewed so the original basis of identifying the 17 identified AEC cannot be fully verified.

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	(CROCL 2020) and note and explain the rationale for any deviations from the plan.	×	Notwithstanding the sampling design for the DSI was comprehensive in terms of focusing on the nominated AEC as well as providing a close grid of sampling locations across the remainder of the site.
Results	Summary of previous results, if applicable. A table(s) of analytical results that: • Shows all essential details such as sample identification numbers and sampling depth, • Shows assessment criteria, • Highlights all results exceeding any assessment criteria (not just the highest), • Includes a summary/discussion of the analytical results, • Includes sample descriptions for all media where applicable (e.g., soil, sediment, surface water, • Groundwater, (data) includes test pit or bore logs (well construction details where appropriate for example groundwater level expressed in Australian height datum), • Includes site plan showing all sample locations, • Includes site plan(s) showing the extent of soil and groundwater contamination exceeding	✓×	As noted above the PSI and SAQP by Jacobs (2020) were not provided. The SAC adopted for the DSI are appropriate for the proposed land use, and SLR included soil aesthetic as a criterion and provided a Summary of Adopted Site Assessment Criteria at Table 7-2 of the DSI. The drawings provided indicate sampling results exceeding the site assessment criteria for soil contaminants, including asbestos, groundwater, soil vapour and surface water. The results are summarised in terms of exceedances in tabular form in the report in addition to being shown on the drawings (Figure 9 series). Figure 10 shows changes made to the sampling regime by SLR from those (apparently) set out by Jacobs in their SAQP (2020). These are presumed to be the result of observations made by SLR during the DSI process. Groundwater data is shown on B1 and shows installation date, well depth, screen interval, SWL, physiochemical parameters and observations. Results tables in Appendix D were presented from pages 607 to 1393. A range of site photographs are presented in Appendix C, although

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	selected assessment criteria for each sampling depth, including identification numbers and depths of all samples analysed, • Follows appropriate statistical procedures when comparing site data with the investigation and screening levels. [Refer to ASC NEPM Schedule B1 sections 2, 3 and 4. Refer to ASC NEPM Schedule B2 sections 13 and 14 for information regarding the data presentation data evaluation]		for a site of 19.5 ha the coverage is not particularly extensive. Test pit and bore logs were provided by SLR in Appendix B of the DSI. These appear reasonably comprehensive, although the details of the bore logger and checker are redacted. Surface elevation and coordinates of the test pits are not provided. Hand augering is shown as the method of drilling on some test pit logs whilst in others no method is recorded. Whether hand augering comprises drilling or test pitting is moot point. Most of the test pits were shallow depth (around 1.0 m). Typographic errors were noted in some logs (asphalt and concrete). Many of the logs seems to include hardstand (concrete or asphalt) with no fill layer which is considered unusual. The thickness of the asphalt layer logged varied (up to 0.2 m metres). Observations of building rubble in fill does not seem to be included on logs for boreholes, however test pit logs contained more detailed observations on some of the logs, including observed potential asbestos containing fragments (ACM). These observations may be relevant if any debris or remnants from the former rifle range were encountered (eg ammunition). PID readings are recorded on the logs and were generally low. Calibration certificates were reportedly provided for the PID and for the YSI equipment (water) however the appendix seems to have blank pages from pages 7565 to 7578 where these PID

Report Section	Required Information	Included / Not Included	Commentary
			certificates were reported to be in Appendix G. Fill thickness is variable but generally quite shallow, followed by fine to coarse sand and in some cases by sandstone. A total of 271 environmental test pit logs are presented. Environmental bores were also logged (using push tube methods) and in some cases recorded observations of potential asbestos containing material in fill. Groundwater well logs showed the materials encountered and well construction details including screening interval and standing water level. Well depths were generally around 8-10 m bgl. Drilling method (hollow flight auger) and rig type were identified but no details were provided of the logger, surface elevation, coordinates etc. Environmental bore logs were also included which extending to deeper depth that the test pits and deployed a push tube (undisturbed) for sampling purposes. Groundwater bore development and stabilisation details were provided involving standard field parameters and appear to have been prepared on site. Results are tabulated in Table B1 for 18 groundwater wells. Numerous site plans (Figures and Drawings) were provided showing the location, depth and extent of soil and groundwater contamination and recording the exceedances of the adopted site assessment criteria. Summary tables of the data were also provided in Tables D1 to D17 (soil), plus D18 (relative percentage differences – RPD, but incorrectly labelled Residual Prediction

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			Deviation). Tables D19 and D20 comprised QA/QC sample results all of which are reasonably comprehensive. Table D21-D22 comprised groundwater summary results and D23 surface water (sewer and septic tank results), whilst Tables D24 and D25 provided a summary of soil gas results. Statistical analysis of sample results was undertaken, but included only maximum, minimum, average and standard deviation. The 95% upper confidence levels of the mean concentrations were not assessed.
Quality assurance/quality control	See Table 2(c) of CROCL	✓×	Summary tables of results, bore logs and laboratory certificates, as well as a detailed assessment of field and laboratory quality assurance and control were provided. Appendix E of the DSI comprises a review of QA/QC results including a summary of data quality indicators (DQI) which noted minor non-conformances. Laboratory certificates from SGS (primary laboratory), Eurofins (secondary laboratory and Symbio (for bacteria) are provided along with Chain of Custody documentation (COCD) and Sample Receipt Notices (SRN). Names of personnel are redacted. SGS is NATA accredited. Certificates include standard reporting requirements, including laboratory QA/QC.
Conceptual site model (CSM)	See Table 2(a) of CROCL	✓×	A CSM is provided in the DSI which appears reasonably complete, although as stated previously the PSI and SAQP were not available. Moreover, the CoPC listed in the CSM are not considered by DP to

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			be fully comprehensive, for example former substations would warrant specific consideration of PCBs as well as other petroleum hydrocarbons and MTBE. It is noted however that PCBs were tested and exceeded the adopted criterion at only one location. Consideration of any observed metal fragments (ammunition) in fill and elevated lead concentrations may be relevant to the former rifle range. Additional analytes relating to explosives could have also been added to the CSM.
Site characterisation	• Assessment of extent of contamination considering all relevant media, including offsite areas, • Assessment of aesthetic issues, • Assessment of secondary toxicity (if conducting an ecological risk assessment), • Assessment of potential effects of contaminants on human health, and built structures (for example arising from risks to service lines from hydrocarbons in groundwater, or risks to concrete from acid sulphate soils), • Assessment of chemical degradation products • Assessment of possible exposure routes and exposed populations (human, ecological), • Any evidence of, or potential for, migration of	✓✖	Based on the data presented the degree, nature and extent of contamination, including aesthetic issues, in soil, groundwater and surface water is considered to have been adequately characterised. Risks to human health and the environment/potential exposure routes appear to have been suitably identified based on the CSM presented. Contaminant migration risks including in groundwater and from asbestos fibres have been identified, but not quantified in the form of a human health risk assessment (HHRA) but this is generally beyond the scope of a DSI and may form a component of later investigations SLR has implied that the site poses minimal risk although significant dust blow effects are mentioned but are not defined or quantified in terms of on-site or off site risk although off site risk potential is identified in the CSM.

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	contaminants from the site, including odour, air quality, stormwater, sedimentation, soil vapour, ground gases and groundwater issues.		
Waste management (if applicable)	• Waste classification details in accordance with EPA Waste Classification Guidelines (see waste classification checklist – Table 2(d) of CROCL 2020. • Statements regarding materials being disposed via appropriately licensed facility or re-used under an order or exemption. • Waste disposal dockets or other waste documentation for any disposed waste.	✓ ×	Guidelines for waste classification are listed in Section 7.4, however no formal waste classification has been provided at this stage, but one will be required for future remediation or redevelopment works if soil or fill material is designated for off-site disposal.
Conclusions and recommendations	Summary of all findings, including: • Conclusions addressing the stated objectives. • Assumptions used in reaching the conclusions. • Extent of uncertainties in the results, • A clear-cut statement that the consultant considers the site to be suitable for the proposed use (where applicable). • A statement detailing all limitations and constraints on the use of the site.	✓ ×	Assumptions and uncertainties not reported in this section but covered elsewhere in the report. No comment made regarding the suitability for the current use of the site and any risks involved with the presence of asbestos although the wording implies limited risk except in the case of significant dust blow [which might affect both on-site and off-site land users]. SLR implied minimal risk from asbestos by simply referencing criteria and excerpts from enHealth (2005), NEPM (2013) and Addison et al (1988) but did not expand on this apparent conclusion or show any evidence of how they arrived at a determination of risk other than by comparing results against published criteria. This may

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			however be sufficient for the purposes of the DSI (see above). It is, however, axiomatic that any ACM at the surface could gradually deteriorate over time and possibly become friable (fibrous) through weathering and/or disintegration via mechanical means. Fibrous asbestos (FA/AF) would be more liable to wind blow than would non friable (bonded) ACM. Fibrous asbestos has already been identified on the site (i.e. Section 8.3 of the DSI indicated that: '…*asbestos (fragments of ACM, fibrous asbestos and asbestos fines) was observed to be widespread across the site*…'.) SLR have listed the requirement for further groundwater monitoring to be undertaken to address the data gaps / uncertainties in relation to groundwater contamination at the site. A consideration should also be given as to the local groundwater flow direction and the possible impact of CHC and PFAS contaminated groundwater on the Randwick Environmental Park/Community Centre. Table 8.5 (data quality objectives) of the DSI indicated that one of the purposes of the data set presented in the DSI was to: '… *assess the suitability of the site for the proposed residential land use, and identify whether further assessment, risk assessment or other management measures is required including further delineation of impacted soils with statistical analysis of results where appropriate*…'. and

Report Section	Required Information	Included / Not Included	Commentary
			'…*further statistical analysis of SAC exceedances could be undertaken to assist in assessing potential risks…*' Based on the findings of the DSI SLR were apparently of the view that a risk assessment was not required as one was not undertaken or recommended. However, this aspect of the CRM was not closed off in the conclusions of the DSI. To determine (quantify) risk in respect of asbestos (or other contaminants) would involve completing a formal HHRA. Alternatively, DP suggest an Interim Asbestos Management Plan could be undertaken to address the present risk posed by asbestos contaminated soil at the site and possible dust generation and impacts off site including on the Randwick Environmental Park/Community Centre.

✓Included × Not included

The proposed development is presented as 'not presently confirmed' and the purpose of the DSI was for due diligence investigations to inform the decision-making process with respect to possible future land use scenarios including low density residential premises. The peer reviewer notes that when more information is available regarding the proposed development additional review of the sampling results presented in the DSI may be required (e.g., if basements are required then the HSL for groundwater will need to be considered in terms of prospective dewatering requirements and the potential for drawing in contaminated groundwater from adjacent sites).

4.2 Scope of the DSI

The scope of work for the DSI was apparently based on the identification of 17 AEC by Jacobs in their PSI and on the Jacobs (2020b) Sampling Analysis and Quality Plan (SAQP). Neither of these documents were provided for review and accordingly no comments can be provided regarding the overall accuracy, completeness, or appropriateness of the identified AEC.

Three of the identified AEC are apparently off-site to the north on the opposite side of Bundock Street and to west of the site boundary. Similarly, the site history which was presumably provided in the PSI

was not reproduced in any great detail in the DSI and accordingly the basis for the identification of the AEC is not particularly clear nor can it be confirmed whether the AEC were fully comprehensive. Notwithstanding, the scope of the DSI and the amount of sampling undertaken is most likely to have identified any additional AEC not previously pinpointed in the PSI.

The site investigation (SI) component of the DSI comprised:

- Excavation of 264 test pits to a maximum depth of 2.6 metres below ground level (m bgl). It is noted that where a proposed test pit was located on concrete hardstand, this was advanced as a borehole using a drill rig to a maximum depth of 3 m bgl;
- Drilling of 75 soil boreholes to a maximum depth of 4 m bgl using a sonic rig as well as a track mounted Rig using push tube techniques;
- Drilling of 68 shallow soil boreholes to a maximum depth of 0.7 m bgl using a hand auger as well as a track-mounted drill rig using push tube techniques;
- Sampling of six soil stockpiles (with volumes ranging between 1 m^3 and 65 m^3);
- Drilling at 65 locations using a Membrane Interface Probe (MIP);
- Installation of 24 groundwater monitoring wells (one within a perched aquifer and the remaining wells in the unconfined aquifer within the Quaternary sediments);
- Installation of PSG probes at 37 locations to a maximum depth of 1.2 m bgl;
- Installation of ASG probes at 6 locations to a maximum depth of 1.2 m bgl; and
- Submission of soil, groundwater and soil vapour samples to a National Association of Testing Authorities (NATA) accredited laboratory for analysis.

It is noted that some departures from the original SAQP were reported, and these are itemised in the DSI. As the SAQP was not available for review it is not feasible to determine to what degree these departures from the scope envisaged in the SAQP may have detracted from the outcome of the testing programme. SLR reported that changes to the SAQP, as listed in Table 6-4 of the DSI, were agreed by the appointed auditor (identity not known). The changes to reported activity added / changed and the addenda to the scope of works appear to be reasonable based on the contents of Table 6-4.

4.3 Sampling Density

Based on the reported site area (19.5 ha) the number of sampling locations undertaken as part of the DSI is considered to be sufficient and is in general compliance with the Sampling Design Guidelines (1995 and 2022), it is, however, noted that at the time of the report the previous version of the guidance was still in effect. A revision to the report should make reference to the updated Sampling Design Guidelines NSW EPA 2022.

Based on the assumption of sampling on a random grid a site area of 19.5 ha would require a minimum of 113 sampling locations, with an equivalent sampling density of 5.82 sampling points per hectare. However, the identification of 17 AEC by Jacobs suggests that the sampling undertaken in the DSI was at least partially focussed on the identified AEC. The AEC are shown in the DSI at Figure 3-1 in Appendix A.

Each AEC/stockpile is depicted as a circular area, and each appears to have the same dimensions. AEC 10, 16 and 17 appear to be off site and thus not specifically relevant (unless there is a risk of onsite migration of contaminants from these AEC. Other AEC appear to follow the boundaries of existing or former structures. Figure 3-2 of the DSI shows the overall sampling layout (design) which appears to comprise both grid and focussed elements with the grid element likely being sufficient to identify any previously unknown AEC. The sampling design as listed in Section 4.2 appears to be largely compliant with NSW EPA (2022).

The review of site history in Section 5.3.1 should include a table of any prior results including groundwater results with relative standing water level measurements over time.

4.4 Sampling Results

4.4.1 Soil

SLR (the DSI) reported that asbestos in the form of asbestos fibres (fibrous asbestos and asbestos fines) and ACMs was present across the site and is concentrated in the vicinity of the former Naval Stores, particularly in vegetated areas along the northern portion of the site, underlying the vegetated strips on the verges of the concrete slabs, in filled areas towards the south western boundary of the site, and to a lesser extent on the south eastern part of the site. SLR noted that the bulk of asbestos impacted soils appeared to be at (or near) the surface to approximately 0.2 m bgl (depth).

SLR reported that benzo(a)pyrene [B(a)P] toxicity equivalent quotient (TEQ) exceeded the adopted health-based Investigation level (HIL-A) at 20 locations, with polycyclic aromatic hydrocarbons (PAH) [total] exceeding HIL-A at five locations.

B(a)P exceeded the ecological screening levels (ESLs) at eight locations. B(a)P impacted soils were predominantly in the northern and north-western portions of the site, and generally encountered in areas also impacted by asbestos. Naphthalene also exceeded the adopted site assessment criteria (SAC) at three locations.

Concentrations of cadmium, chromium (III+VI), copper, lead, mercury, nickel or zinc either singularly or in some combination exceeded the EILs for public open space in 51 sample locations.

The concentrations of chromium (III+VI), copper, and lead, either singularly or in some combination exceeded the HILs in 8 samples. SLR noted one sample (0407_TP73_0.1_200619) was reported as exceeding the HIL-A for hexavalent chromium, however the analytical result is for total chromium. Hexavalent chromium was not expected to be present on site based on the historical land uses, although the DSI (as a free-standing document and without the benefit of the preceding PSI) is not particularly informative in this regard.

Petroleum hydrocarbons at eleven (11) locations exceeding the ESLs in shallow soils. Polychlorinated biphenyls (PCBs) at one (1) location exceeded the HIL in shallow soils (see previous comment regarding transformers/substations).

4.4.2 Groundwater

From the groundwater sampling results SLR noted that copper and zinc exceeded the adopted site assessment criteria at 13 locations, with arsenic and nickel exceeding at one location, and lead at two sampling locations. The DSI reported that heavy metal concentrations were relatively consistent across the site. SLR also noted that the results were comparable to those at the background sampling location and concluded that heavy metal concentrations in groundwater onsite were representative of background conditions. This conclusion seems reasonable and is likely the result of service leakage and/or contamination from diffuse sources either onsite or off-site (or both). The metal results are not considered to be of environmental significance or concern.

Chlorpyrifos (OPP) exceeded the SAC at one location (GW13a) in one sampling event. SLR considered this result to be an outlier, as pesticides were generally less than the laboratory limit of reporting in soils and groundwater which indicates the site is unlikely to be the primary or an ongoing source of chlorpyrifos impact to groundwater. Again, this conclusion seems reasonable although the outlier could result from an unidentified / unknown point source on the site.

SLR also noted that the sum of PFHxS & PFOS (PFAS compounds) exceed the SAC in ten locations but noted that PFAS was generally not detected in soils sampled onsite and as the site is primarily vacant, the site is unlikely to be the primary source, or an ongoing source of PFAS impact to groundwater.

Noting the multiple potential sources of PFAS contamination which are feasible on DoD sites this conclusion is considered by the reviewer to warrant further investigation, although it is noted that SLR also indicated that the PFAS levels reported are likely to represent broader regional impacts from multiple sources, which is considered quite feasible bearing in mind its ubiquity. SLR however noted that there are likely to be at least two sources of PFAS on-site; the first being the regional groundwater aquifer, whilst the second source area is located on-site in the vicinity of the former metal treatment works, chemical storage yard and the former vehicle washing refuelling and maintenance yard. Accordingly, it seems reasonable to assume that a specific PFAS source could be present on the site and would warrant further investigation and possible specific remediation.

SLR also noted that based on the limited data available the likely source of chlorinated hydrocarbons is off-site because the concentrations of tetrachloroethene (PCE), trichloroethene (TCE) and cis-1,2-dichloroethene (DCE), trans-1,2-DCE/1,1-DCE, are highest in the upgradient monitoring wells (GW13a &b, GW14, GW15 and GW18). SLR opined that the offsite source is potentially the former laundrette [dry cleaners] adjacent to the northwest corner of the site as the ratio of cis-1,2-DCE to trans-1,2-DCE plus 1,1-DCE is greater than about 5:1 and that the observed DCE is likely to be the result of degradation of TCE and / or PCE. The conclusion appears to be reasonable although there is limited evidence to support the contention that the laundrette is also a dry-cleaning facility, or that inappropriate disposal of spent dry cleaning fluids took place on the site (although this is not uncommon). The presence of the former metal treatment works may be a source of the above contaminants (solvents) which are often used in metal processing and cleaning.

It is also not clear from the drawings provided whether the soil and groundwater sampling locations in the vicinity of each AEC were analysed for the appropriate contaminants of concern as were presumably outlined in the PSI and SAQP, although a listing of contaminants tested for each AEC is provided and appears to be reasonable.

Aquifer testing (slug tests) to determine groundwater flow characteristics were undertaken by SLR in 9 bores (wells) with variable results for permeability (K) ranging from 0.005 m/day in sandstone to 8- 29 m/day in the overlying sand formation. The results suggest that groundwater flow in the sands may be quite rapid depending on the gradient although this was not directly reported. Slug test results recording aquifer permeability test results (BouwerRice Method) were presented in Appendix H and appear to have been appropriately conducted.

SLR reported that regional groundwater flow direction within the Botany Basin generally conforms to topography and flows south towards Botany Bay.

Groundwater levels were recorded in the aquifer at the site and were used to interpolate groundwater contours as shown in Figure 7-1 and Figure 7-2 in. Accordingly, it seems plausible that the groundwater levels and flow directions reported are reasonably likely. Notwithstanding, it is noted that surface elevations are not recorded on the groundwater well logs (along with coordinates) and accordingly the basis for the groundwater contours and flow direction is not determinable. Presumably this key data is recorded elsewhere but should have been included on the logs.

SLR noted that further groundwater monitoring should be undertaken to address the data gaps / uncertainties identified (which should include further assessment of the source of PFAS in groundwater) and that the preparation of a Remediation Action Plan (RAP) is required to detail the remediation, validation and management requirements for the identified contamination and in order to confirm the suitability of the site for a change in land use. These conclusions and recommendations seem reasonable and appropriate based on the information presented in the DSI.

4.4.3 Soil Gas

Measurement of soil gas using passive soil gas (PSG) methods showed detections of chloroform, tetrachloroethene, toluene and trichloroethene, with the highest concentrations reported in the northern portion of AEC12 (the former metal treatment works).

Concentrations of trichloroethene were found to exceed the adopted SAC in the northern portion of AEC12 during active soil gas (ASG) monitoring following the PSG sampling. The source of soil gas (the metal works) is plausible (also see previous comment on PFAS contamination), but the level of risk posed by the reported soil gas levels, particularly TCE, has not been defined, although the proposed further works as listed below should address this data gap.

SLR did however conduct a risk screening exercise as part of their conceptual site model (Table 9-3 of the DSI) which considers the potential types and sources of contamination, transport mechanisms, exposure routes, receptors and linkages (completeness of exposure route).

MIP data were presented in Appendix I which includes down-the-hole plots of PID, FID, XSD, HPT and EC.

SLR reported that DHA is undertaking due diligence investigations to inform the decision making process with respect to possible future land use scenarios including low density residential premises, however the proposed development has not been defined.

When the design of the proposed development is devised and the presence/ construction methods for basements, final elevations, possible dewatering etc are known the results should be considered in more detail.

Based on the desk top review, evaluation of site history (essentially based on previous work by Jacobs), site inspection and testing results which comprised (various) components of the DSI, SLR concluded that the site can be made suitable for a residential land use subject to the following provisos and recommendations:

- The management of bonded ACM fragments and asbestos (fibrous asbestos and asbestos fines) associated with historical activities on site. This includes the fill material in the high voltage easement on the western boundary of the site [note this may also include stockpiles if present];
- The management of elevated concentrations of B(a)P, PAHs and metals in surface soils primarily across the northern portion of the site. Management of petroleum hydrocarbons and PCBs at discrete locations [note a Remedial Action Plan (RAP) will be required in this regard];
- Further monitoring of the groundwater quality and properties on site, including PFAS, as well as TCE in and surrounding AEC12 (Former Metal Treatment Works). This should include the installation of additional groundwater monitoring bores in the vicinity of AEC12 [note: an SAQP will be required to confirm the details of the proposed monitoring and should also include PFAS];
- Preparation of a Hazardous Building Material (HBM) assessment of remaining buildings where they require demolition. [note: appropriate sign-off will be required by an approved person to state that no HBMs have been left on the site as a result of demolition]; and
- Further testing has also been recommended on the western side of the site in a previously inaccessible area (high voltage electrical infrastructure).

These recommendations appear reasonable based on the results presented in the DSI.

4.5 Site Assessment Criteria

The comparative criteria used to assess the environmental media (soil, soil vapour, soil aesthetics, groundwater, asbestos etc) cover the range of potential land uses to which the site may be put in the future and are based on NEPC, 2013. As the actual future land use is not known this seems to be a reasonable approach. Waste assessment criteria applicable in NSW were also used to determine the classification.

CEC and pH values were used to calculate EILs and these were taken from a range of locations and material types as recommended in NEPM (NEPC, 2013).

Criteria for explosive residues were also included, although the source of the criteria was not evident. No evidence of explosives (unexploded ordnance - UXO) was found including from a ground penetrating radar (GPR) survey. The GPR and UXO clearances were undertaken in the former Rifle Range (AEC 3) and Grenade Bursting Range (AEC 4) areas. A GPR survey was also undertaken around fuel storage infrastructure and transport compound (AEC 8). Some anomalies were reported, but no details were provided as to the methodology adopted or the results of the survey.

Section 7.1.3 describes the screening criteria adopted for asbestos which are appropriate, but SLR also noted in Section 10.1 that:
'…

- *Occurrences of ACM was predominantly observed in surface soils (0 to 0.2 mbgl) and up to depths of 2.2 m bgl in discrete portions along the western boundary of the site and around the former Naval Store concrete slabs.*
- *Occurrences of asbestos fibres (fibrous asbestos and asbestos fines) were also predominantly observed in surface soils (0-0.2 mbgl) and up to depths of 1.5 mbgl in in certain pockets along the western boundary of the site. Occurrences of asbestos fibres and ACMs were not observed beneath concrete hardstand areas that formed the foundation of the former Naval Stores, suggesting that asbestos occurrence across the rest of the site was potentially from the staged demolition of the former Naval Stores.*
- *The bulk of asbestos impacted soils appears to be in the soil surface to approximately 0.2 mbgl.*
- *enHealth (2005) refers to a study by Addison et al. (1988) which demonstrated that the asbestos concentration in air is unlikely to occur above 0.1 f/mL (occupational exposure standard) under controlled conditions where 5 mg/m of respirable dust is generated from soil containing 0.001% asbestos (w/w homogeneous sample) asbestos in dry soil, in air. This study was undertaken to determine a practical limit for the asbestos content of contaminated land below which no further decontamination would be necessary as soil 'free of asbestos' would be unattainable or impractical[1].*
- *In addition, if the asbestos fibre is reasonably well fixed into a bonding matrix and not mechanically disintegrated into dust, it does not present a significant dust hazard. The study found that unless considerable dust clouds are generated it would not be possible to measure airborne fibre levels at the levels required. The study recommended a level of 0.001% below which, no action would be required to decontaminate further or to protect workers specifically from asbestos dust*[2]…'.

SLR further indicated that:

'…*Based on the information gathered during the desktop review, the observations made during the site walkover and the results of the sampling undertaken, SLR concludes that the site can be made suitable for a residential land use subject (inter alia) to the following regarding to asbestos:*

'…*the management of bonded ACM fragments and asbestos fibres (fibrous asbestos and asbestos fines) associated with historical activities on site. This includes the fill material in the high voltage easement on the western boundary of the site*…'.

SLR appear to be silent regarding whether the reference to 'management' is restricted to the period of remediation following further testing, or whether ongoing management such as dust control is currently required at the site along with any related monitoring of airborne dust (and asbestos fibres) at the boundary. As noted elsewhere in this report, no formal risk assessment in relation to asbestos has apparently been undertaken by SLR or others, neither has one has not been recommended in the DSI.

[1] DP notes that this study was undertaken some time ago and may not replicate Australian climatic conditions which may experience longer dry spells and stronger winds than those studied in Addison et al (1988). In addition, weathering and mechanical disintegration over time will inevitably increase the proportion of asbestos fines at or near the ground surface.
[2] See above.

However, it might reasonably be expected that such a study would be required (by the auditor) to determine the current status of the site and to evaluate the risks to human health (if any) from asbestos and that this would be expected to encompass both the period prior to as well as during remediation, including assessment of risk from the current land use.

Based on the findings of the DSI, SLR were apparently of the view that a risk assessment was not required as none was recommended in the report. As a result, this aspect of the CRM was not closed off in the conclusions of the DSI.

To determine (quantify) risk in respect of asbestos (or other contaminants) would involve completing a formal HHRA..

A summary of the site assessment criteria was provided in Table 7-2 of the DSI along with a summary of the exceedances of the adopted SAC (for metals and PAHs) as shown in Tables 8-3 and 8-4 of the DSI. These seem to be appropriate for the future land use stated in the DSI (although no details are yet available).

4.6 Aesthetic Issues

SLR recognised soil aesthetics as a potential AEC and noted that staining and odours may comprise an issue on site and should be assessed. In this regard SLR noted that minor staining presumed to be associated with vehicle parking and minor spills on the hardstand were observed on the surface of the former heavy vehicle transport yard (AEC8) compound, and that stockpiles of construction and demolition waste were present at various locations across the site. These are described in Table 8-1 of the DSI, although volumes are indicated for only a few of the stockpiles identified.

5. Conclusions & Recommendations

The draft DSI report by SLR appears to be quite comprehensive and is generally compliant with the published guidelines, including those made and endorsed by the NSW EPA under the Contaminated Land Management Act, 1997.

Sampling design seem to be appropriate on the assumption that the AEC identified by Jacobs in the PSI (2020) are accurate and that no AEC has been missed. Notwithstanding, an apparently sufficient number of grid-based and targeted samples were undertaken by SLR to determine whether any further AEC were present, although it is noted that no amount of sampling can be foolproof in this regard.

Groundwater, soil vapour and asbestos sampling densities similarly appear to have been sufficient to reasonably characterize the site and are in general compliance with published guidelines.

Additional sampling to address areas of limited access (under concrete slabs and existing structures and in other data gap areas) should be undertaken as part of the RAP i.e. a data gap assessment. The use of test pits rather than boreholes for this assessment is recommended (DP notes that the currently DSI employed borehole in areas of concrete hardstand), particularly in respect of asbestos sampling.

It is also noted that formal waste classification will be required for any soil or fill materials which require to be removed off-site as part of any remediation works or future development.

Sources of contamination at the site was generally addressed by SLR in the CSM in Section 9.1.1 to include: soil and fill materials impacted by asbestos, surface soils in the north-western portion impacted by metals and PAHs, groundwater with chlorinated hydrocarbons and PFAS impacts.

Groundwater is contaminated with generally low levels of certain metals and organic compounds at levels which in places exceed the SAC, but these are essentially restricted to chlorinated compounds and PFAS from AEC 12 the former metal works. Further groundwater well installation and testing are thus required particularly in the area of AEC12, the former metal treatment works, and should focus on a range of organics, including chlorinated solvents and PFAS. Further testing of groundwater is recommended by SLR which will be used to assess risk posed to the site and surrounding sites (such as the Randwick Environmental Park). This risk posed by groundwater is not explicitly discussed in the draft DSI.

If dewatering becomes necessary as part of the future works, then the treatment of contaminated groundwater for off-site disposal my need to be considered as part of a dewatering management plan.

From the information presented in the DSI the main issues include the presence of significant amounts of surficial and shallow asbestos principally in the form of fragments of asbestos cement sheeting, and other contaminants which are also present in either minor amounts or in isolated and sporadic locations in shallow soils.

In addition, SLR recommended the preparation of an RAP to manage *inter alia* the occurrence of widespread asbestos contamination and B(a)P, PAHs and metals in surface soils primarily across the northern portion of the site.

The risk to neighbouring sites (and in particular the Randwick Environmental Park) posed by the identified sources were generally addressed in the CSM however as discussed by DP an assessment of actual risk has not been provided in the DSI and therefore cannot be reviewed on relied on by DP. DP is unable to comment further on the actual risk posed either on-site or off site, as this has not been quantified by SLR by means of a formal risk assessment. However some implied assessments of risk are discussed in the following sections.

Based on DP's review of the DSI, it appears that SLR are of the view (implied) that the site poses limited risk (from asbestos), except during significant dust blows. However, this opinion is implied by SLR only via reference to enHealth (2005) and Addison et all (1988), i.e., as summarised in Section 10.1 of the DSI (see below) and is not stated specifically. In addition, SLR is silent on whether interim management of surficial asbestos is required prior to remediation. However, since this is not listed as a requirement the inference is that SLR believe that neither an Interim AMP or an HHRA are required.

SLR did not define what constitutes a significant dust blow hazard in terms of wind direction or velocity, nor make any recommendations regarding determining risk via a formal HHRA, or propose dust monitoring at the site boundary, although the latter (and perhaps the former) might be expected as a component of remediation and are likely to be required by the auditor.

DP considers it is reasonable to assume that significant dust blows are most likely to occur during soil disturbance/earthworks/remediation on site, but might also occur at other times depending on prevailing

weather conditions, the condition of the surface soils containing asbestos and the nature of the asbestos in those soils. SLR did not comment on these issues specifically other than stating that '…*asbestos (fragments of ACM, fibrous asbestos and asbestos fines) was observed to be widespread across the site*…').

Fibre intake by humans (risk) adjacent to the site would generally only occur only if asbestos fibres became airborne and were then transported within the site and thence beyond the site boundary by the prevailing winds. No monitoring of this situation appears to have been recommended but might be expected (by the auditor) during site remediation, if not before. Nevertheless, SLR has implied that the management of bonded ACM fragments and AF/FA is required by recommending the preparation of a RAP which may further imply that a risk is posed by asbestos on the site. Notwithstanding, SLR, have not indicated that the site poses a significant risk of harm as defined under the Contaminated Land Management Ac, 1997 or that it should be notified under S.60 of the Act, which suggests that SLR has formed the view that off-site risks are acceptable, albeit without formal quantification.

As noted above SLR has not dealt with this issue specifically in their Draft DSI and no formal human HHRA (in respect to asbestos) is understood to have been undertaken. Accordingly, and as far as is known from the information supplied, the off-site health risks posed by asbestos remain unquantified including any risks to the adjoining land (including Randwick Environmental Park/Community Centre).

The scope of work, investigations undertaken, the findings, assessment and recommendation made by SLR in the draft DSI seem both reasonable and practical based on the information available, other than the absence of any formalised assessment of on-site or off-site risk. This however may comprise a subsequent component of the investigations.

The DSI recommendations do not include the requirement for a HHRA to determine current risks (posed for example by surficial asbestos) and future risks during remediation, or indeed in regard to future land uses.

SLR also does not list the requirement for an Interim Asbestos Management Plan (AMP). This could be recommended as an alternative to an HHRA, with the objective to protection current users and users of neighbouring sites (including the Randwick Environmental Park) from possible impacts of widespread asbestos impacted surface soils at the site and off site migration of such impacts (if they were to occur). DP consider an Interim AMP could include mitigation measures in case of dust generation due to adverse weather conditions (wind, dry periods), and during future investigation/remediation and construction works.

Remediation of surface and near surface asbestos will, in particular, need to be carefully managed to ensure that fugitive dust and fibres are not released and do not become airborne during works as this could lead to potential impacts on adjacent land users as well as workers on site.

The consideration for future data gap analysis should also be informed by any concept plan or masterplan or proposed development which is prepared for the site.

Depending on the outcome of remediation it is feasible that an EMP may be required to manage retained contamination (on site) over the longer term.

6. References

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7. Limitations

Douglas Partners (DP) has prepared this report for the site located at Randwick Barracks, 373A Avoca Street, Randwick, NSW in accordance with DP's proposal 219204.00 P.001 dated 8 November 2022 and subsequently a further proposal dated 16 December 2022, and acceptance received from Oscar Guillen dated 18 November 2022.and further instructions dated 5 January 2023.

This report is provided for the exclusive use of Randwick City Council for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and / or their agents.

The results provided (reviewed) in the report were provided by others and are necessarily indicative of the sub-surface conditions on the site undertaken only at the specific sampling and / or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after field testing has been completed.

DP's advice is based upon the conditions encountered during the investigations reported in the DSI. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations determined by others.

The assessment of atypical safety hazards is not part of the scope of work and similarly 'safety in design' assessment is outside the current scope of this report.

This report must be read in conjunction with all attachments and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion or work by others rather than instructions for construction.

Yours faithfully
Douglas Partners Pty Ltd

Dr. Paula Maurici
Associate

Reviewed by

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