Environmental Site Assessment – Final Site Condition
Kingswood Golf Course, 179-217 Centre Dandenong Road, Dingley Village

Prepared for:
AS Residential Property No.1 Pty Ltd
Distribution

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1.0 Introduction and Objectives

Senversa Pty Ltd was engaged by AS Residential Property No.1 Pty Ltd (ASRP1) to complete three Environmental Site Assessments (ESA) of the final site condition, at the Kingswood Golf Course, 179-217 Centre Dandenong Road, Dingley Village (the site).

The site boundary and site features including groundwater and landfill gas monitoring locations are shown in Figure 1. The location of soil bore and test pit locations is provided within other previous environmental assessment works undertaken at the site.

1.1 Background

The site has been used as a golf course since approximately 1937 with facilities including; 18 hole course, several surface water bodies of which stormwater from surrounding streets feed into, club house with grease trap and maintenance facilities including storage sheds and offices, workshop, banded above-ground fuel storage, vehicle/chemical wash down area with triple interceptor trap (TIT) and pesticide/herbicide storage areas. Several landfills exist within the area including the former Spring Road Landfill, located immediately east of the site.

ASRP1 purchased the site in early 2015 and propose to redevelop the site into a mixed use low density residential development, potentially with some commercial buildings. No basements or piling foundations are currently proposed as part of the redevelopment.

1.2 Objective

The objective of this report was to provide an opinion on whether an environmental audit is required and an opinion on the suitability of the site for the proposed development.

1.2.1 Basis for Forming an Opinion

Senversa has used the Potentially Contaminated Land - General Practice Note (DSE, 2005) (Practice Note) to demonstrate to the satisfaction of the Responsible Authority that the site is suitable for the proposed use. Page 5 of the Practice Note states that:

An environmental audit should be required unless the proponent can demonstrate to the satisfaction of the responsible authority that the site has never been used for a potentially contaminating activity, or that other strategies or programs are in place to effectively manage any contamination.

Senversa has also considered the Planning and Environment Act 1987, Ministerial Direction number 1 - Planning, Heritage and Building Division, to assess the need for an environmental audit and to demonstrate to the satisfaction of the Responsible authority that an amendment to the planning scheme allowing a sensitive use (i.e. residential) is suitable at the site.

This process is discussed in Section 2.4 of the report.

1.2.2 Works Completed to Demonstrate Suitability for Use

The following environmental assessment works have been completed at the site and are summarised in Section 3 of this report:

1. Preliminary Site Investigation (PSI)

   A PSI was conducted to determine historical site uses and whether or not potential contaminating activities exist/ed at the site.
2. **Targeted Soil Contamination Assessment**
   The soil assessment was undertaken to target potential contaminating sources identified in the PSI.

3. **Preliminary Landfill Gas Assessment (LFG)**
   The Preliminary LFG Assessment was undertaken to assess the risk of LFG migrating from the former Spring Road Landfill, onto the site.

4. **Geotechnical Investigation**
   The Geotechnical Investigation was undertaken to assess the geological and geotechnical considerations for the proposed redevelopment.

5. **Supplementary ESA**
   The Supplementary ESA was undertaken to assess the potential for site-derived contamination at select locations, and potential LFG and impacted groundwater from the neighbouring former Spring Road Landfill to impact on the proposed redevelopment.

6. **Further ESA**
   The further ESA was completed to assess whether surface water, groundwater and LFG impacts (if present) are considered acceptable for the proposed future land use without ongoing environmental management requirements or development constraints.

### 1.3 About Senversa

Senversa is a specialist environmental consulting firm. Our key staff members provide high quality skills and experience in soil and groundwater contamination assessment, landfill gas and soil vapour risk assessment, management and remediation and have a proven track record in building high quality consulting teams. Senversa has a strong knowledge of regulatory requirements associated with contaminated land assessment and has 10 EPA-appointed Environmental Auditors (six of which are Victoria appointed). Senversa is also a member of the Australian Contaminated Land Consultants Association as well as having individual memberships with the Australasian Land & Groundwater Association, which are considered to be Australia’s peak industry bodies of land assessment and remediation.
2.0 Site Assessment Works Completed and Recommended Future Actions

Between 2014 and 2015, several environmental investigations have been completed at the site as listed below in chronological order (copies of all the assessment reports are provided as part of this lodgement application).

- Senversa, 2014. Preliminary Landfill Gas Assessment, 179-217 Centre Dandenong Road, Dingley Village, Senversa Pty Ltd.
- Senversa, 2015a. Supplementary Environmental Site Assessment, Kingswood Golf Course, 179-217 Centre Dandenong Road, Dingley Village, Senversa Pty Ltd.
- Senversa, 2015b. Further Environmental Site Assessment, Kingswood Golf Course, 179-217 Centre Dandenong Road, Dingley Village, Senversa Pty Ltd.

Pertinent findings of previous environmental assessments are summarised in the sections below.

2.1 Site Assessment Works

2.1.1 Preliminary Site Investigation

The PSI was undertaken to assess the potential for and location of soil and / or groundwater contamination at the site. The site history review and inspection identified the following potential sources of contamination on-site: historical building demolition (residential farmhouse, chemical store), historical maintenance facility with associated fuel storage (likely to have been in 44 gallon drums), existing maintenance facility and associated TIT, bunded waste oil above ground storage tank (AST), bunded diesel and unleaded petrol AST, petrol and oil interceptor, bunded fertiliser and chemical storage area, used chemical storage area, two disused mobile ASTs, grease interceptor trap and TIT east of the clubhouse, historical agricultural use and imported fill (potentially from a nearby service station).

Three Type 2 landfills (i.e. putrescible waste filled) were identified within 500 m of the site which were recognised as potential off-site sources of contamination. It was recommended that discussions be held between Environment Protection Authority (Victoria) (EPA) and the relevant planning authority to assess the requirement for a LFG investigation to assess potential impact from surrounding landfills.

2.1.2 Targeted Soil Contamination Assessment

The Targeted Soil Contamination Assessment was undertaken to target potential contaminating sources identified within the PSI phase of works. The scope of works included 21 targeted soil bores surrounding the existing and former maintenance facility areas and historical building demolition area.

An elevated concentration of zinc above adopted investigation levels was reported at one sample location. Generally low pH concentrations were reported at the targeted locations which ranged from 4.1-7.8 pH units. The results of the targeted investigation indicated that the risk posed to human health and the environment was considered to be low and acceptable.
2.1.3 Preliminary Landfill Gas Assessment

A Preliminary Landfill Gas Assessment was undertaken to assess the risk to site redevelopment of LFG migrating from the former Spring Road Landfill, onto the site. The scope of works included the installation of 11 LFG bores, completion of two static LFG monitoring events, continuous LFG monitoring within two bores and service pit monitoring along Spring Road.

The investigation did not identify any particular preferential subsurface pathway for gas migration, with the exception of the areas geological profile (i.e. sands) which can be conducive to LFG migration. No methane was detected within the on-site LFG bores or service pits along Spring Road, however, elevated carbon dioxide concentrations were detected above adopted action levels ranging between 0.0-5.9% volume by volume (v/v). The risk of LFG migration from the former Spring Road Landfill was considered to be low and acceptable with no specific development constraint identified.

2.1.4 Geotechnical Investigation

The Geotechnical Investigation was undertaken to assess the geological and geotechnical considerations for the proposed redevelopment. The scope of works included 23 soil bores, 15 dynamic cone penetration tests and installation of three groundwater monitoring wells.

Relevant geological and hydrogeological aspects have been incorporated within the above sections. Recommendations included further groundwater monitoring to assess impact to proposed structures and dams, more detailed review of proposed construction materials and design of proposed ponds/wetlands, inspections of subgrade, footing exposures and fill placement.

2.1.5 Supplementary Environmental Site Assessment

The Supplementary Environmental Site Assessment was undertaken to assess the potential for site-derived contamination at select locations, and potential LFG and impacted groundwater from the neighbouring former Spring Road Landfill to impact on the proposed redevelopment. The scope of work included soil sampling at 10 locations, groundwater sampling at 6 locations, 3 static LFG monitoring events at on-site and select off-site bores and services along Spring Road and continuous monitoring at 4 locations.

The LFG risk assessment indicated that the site is generally a very low risk, with the exception of elevated flow and carbon dioxide at GB19 which increased the risk to moderate surrounding this location (refer to Section 2.1.6 for further discussion). Soil analytical results were below adopted investigation levels and are not expected to present an unacceptable risk to human health or environment as part of the proposed sensitive use development. Lead, nickel, sulphate, benzene and hydrocarbons were elevated above background concentrations at either GB01 or GB19. These results may be associated with leachate impacted groundwater from the former Spring Road Landfill.

2.1.6 Further Environmental Site Assessment

The Further Environmental Site Assessment was undertaken to assess the risk to surface water, groundwater and LFG to confirm whether or not the site and proposed future land use is considered acceptable with no ongoing environmental management requirements or development constraints. The scope of work included installation of 4 dual purpose groundwater and LFG bores, groundwater sampling at 10 locations, surface water sampling of two water bodies, at four monitoring points, likely to be retained as part of the proposed development, 2 static LFG monitoring events at on-site and select off-site bores and services along Spring Road and continuous monitoring at one location.

The LFG site specific risk assessment, conducted in accordance with the process outlined in CIRIA (2007) recommended methodologies, indicated that dilution and attenuation effects between the source of ground gases and sub-floor and/or indoor air environment is adequate to ensure that concentrations are below relevant EPA action levels for indoor air within buildings and structures. As such, gas migration protection measures are not considered necessary provided that no basements
are constructed and ongoing LFG, leachate and groundwater monitoring and management is completed by Council at the former Spring Road Landfill.

Elevated concentrations of benzene, mercury, nickel, sulphate, nitrate and ammonia are indicative of leachate impacted groundwater likely to be derived from the adjacent the former Spring Road Landfill (i.e. not site derived pollution). These impacts appear to be isolated to the eastern area of the site and do not represent a vapour intrusion risk under the proposed development scenario. No impact was identified to be attributed to current or former activities of the site. As such, no ongoing monitoring or remedial works of the upper Brighton Group aquifer are considered necessary provided that it is not used extractive use purposes (i.e. potable drinking water, on-site irrigation or filling of swimming pools) and basements or piling foundations are not proposed as part of the future development.

Reported surface water analytical results were predominantly below adopted investigation levels, with the exception of copper and zinc that are considered to be representative of regional and/or naturally occurring background concentrations. Detectable concentrations of total recoverable hydrocarbons (TRH) were reported, however, are inferred to be related to typical urban quality stormwater entering from nearby roadways which discharge into the surface water bodies of the site.

2.2 Off-site Assessment & Clean-Up Works Undertaken – Former Spring Road Landfill

Two environmental reports at the former Spring Road Landfill were available for review, as listed below and are briefly summarised in the following section:


<table>
<thead>
<tr>
<th>Report Scope</th>
<th>Relevant Site Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>URS, 2015</td>
<td>Review of recent site works, environmental risk assessment, preparation of an Environmental Monitoring Program, development of a leachate and groundwater bore monitoring schedule, development of a cap maintenance program.</td>
</tr>
<tr>
<td></td>
<td>A Pollution Abatement Notice (PAN) was issued for the site by the EPA on 3 June 2013. The PAN required that a Landfill Rehabilitation Plan was prepared and an Aftercare Management Plan be prepared (to be verified by an environmental auditor) and implemented until such time that the site does not pose a risk to human health or the environment.</td>
</tr>
<tr>
<td></td>
<td>The site currently consists of part of a closed landfill that has been capped and revegetated, a Council operated mulch drop-off facility and an aged care facility. Prior to the 1960s, the site was used for agricultural and horticultural purposes. Between the 1960s and 1970s, sand mining operations were carried out and from 1980 the site was used for landfilling, excluding the area currently being used as an aged care facility. Landfilling ceased in the early 1990s and a LFG extraction system was installed in 1995 which remains operational (as of May 2015). A poultry farm (Ingham Poultry) also existed along the western site boundary (adjacent Spring Road), which has since been decommissioned (2009/2010).</td>
</tr>
<tr>
<td></td>
<td>The former landfill was divided into four sub-areas: 5, 6, 7, and 8 (refer to Figure 1). Sub-areas 5, 6 and 7 were considered to comprise 70-75% municipal solid waste and unknown proportions of construction and demolition and commercial / industrial materials. Sub-area 8 did not fall below 90% municipal solid waste. Waste thickness is reported to be up to 20 m thick depending on this sub-area.</td>
</tr>
<tr>
<td></td>
<td>The former landfill is not considered to be lined (i.e. in direct hydraulic connection with the underlying regional aquifer) and no known drainage system exists. A 500 mm engineered clay and / or sand washing slime liner was placed immediately above the waste followed by a 300 mm topsoil layer with no known drainage system incorporated into the cap.</td>
</tr>
<tr>
<td></td>
<td>Several leachate ponds of which have been monitored were inferred to exist, however, it is not known how leachate was extracted from the landfill and diverted to the ponds. In 1991, a seepage of leachate from the landfill reportedly flowed onto the Spring Road nature strip over a length of approximately 200 m, between Rowan Road and Marcus Road. An interception</td>
</tr>
</tbody>
</table>
trench was reportedly installed. Three inferred leachate bores and five groundwater monitoring wells have been sampled on up to three occasions.

Calculated hydraulic conductivities within the Brighton Group aquifer ranged between 0.001-0.017 m/day. Seepage velocity within this aquifer was expected to range between 0.01-2.5 m/year. Groundwater flow direction was determined to be southwest.

A LFG cap survey was undertaken in 2013, with six of the 464 monitoring points recording methane above the EPA Best Practice Environmental Management (BPEM) Action Level of 100 parts per million by volume (ppmv). The closest (and highest measurement of 1,711 ppmv) of which was located at a stormwater drain outlet approximately 100 m southeast of the site, adjacent to Spring Road.

Monthly LFG monitoring has occurred on the 45 gas bore network and 36 service pits along Rowan and Spring Roads, between September 2013 and September 2014. Methane and carbon dioxide concentrations have exceeded 80% v/v and 29% v/v respectively within the former landfill footprint. Methane concentrations within LFG bores along the Spring Road nature strip, adjacent to the golf course, have not exceeded the EPA Action Level of 1% v/v. However, carbon dioxide concentrations within LFG bores along the Spring Road nature strip, adjacent to the golf course, ranged from 0.5-11.5% v/v, the majority of which exceeds the EPA Action Level of 1.5% v/v. Background carbon dioxide measurements outside of the former landfill footprint have been determined to range between 1.3-1.9% v/v when the oxygen concentrations are approximately 21% v/v, thus a background carbon dioxide BPEM Action Level of 2.8-3.4% v/v was adopted for the site. Whilst methane was identified within some service pits, no results exceeded the BPEM Action Levels for methane of 1% v/v or 10,000 ppmv.

Mitigation works completed to date have included the installation of 15 passive air vent bores between the site boundary and Rowan Road, seven passive air injection bores near the aged care facility, a shallow 18 m long trench adjacent the aged care facility, four groundwater remediation bores (chemical oxidant injection) adjacent the aged care facility.

The site geology was determined to be conducive to lateral migration of LFG, however, this was deemed constrained by shallow saturated ground conditions, particularly along the western site boundary. It was concluded that the risk to site occupants and adjacent residents from LFG emissions through the cap or subsurface geology into service pits and indoor air were either negligible or acceptable. However, the potential for human health to be impacted from LFG entering buildings from underlying geology was considered unacceptable.

Ongoing LFG monitoring proposed included monthly static measurements of 12 select bores (not along Spring Road), quarterly static measurements for all 45 bores (Spring Road bores included), bi-annual static measurements of service pits and cap emissions, and indoor air monitoring at the aged care facility if methane is detected within nearby bores for two consecutive months. Ongoing leachate monitoring proposed includes quarterly gauging and bi-annual sampling. Ongoing groundwater, stormwater (if identified) and surface water monitoring proposed included quarterly sampling. Annual inspections for a period of five years was also proposed to assess the effectiveness of the closure strategy, after which time the monitoring frequency should be reviewed (i.e. after the March 2019 event). The report also detailed that the existing gas extraction system should remain operational 24 hours/7 days a week.

An environmental audit of the site has not been undertaken and the future need is proposed to be assessed based on the risk posed to beneficial uses.
Report Scope Relevant Site Information

PJRA, 2015 Review of the Aftercare Management Plan (AMP) and auditor verification of the monitoring program.

Peter J Ramsay (Ramsay) was engaged by Council on 13 January 2015 to review the draft AMP prepared by URS and to determine compliance with the amended PAN. The PAN (No. 90003857) was amended on 12 November 2014 after advice from the Victorian Civil and Administrative Tribunal to the EPA to remove reference to any guidelines and only consider impacts to human health (i.e. environment excluded).

Ramsay concluded that the management plan is generally appropriate for aftercare management of potential human health impacts associated with the landfill based on:

- URS’s conclusion that risks to human health from LFG concentrations at the surface of the cap exceeding action levels are negligible based on their assessment of the efficacy of the current gas extraction system.
- Unacceptable risk to human health from the potential subsurface migration of LFG into indoor air and off-site being actively mitigated through passive venting measures and groundwater remediation.
- The management plan recommendations for further investigation and monitoring of surface water and groundwater to ensure that impacts to human health on and adjacent to the landfill are implemented.

Ramsay considered the recommendations and triggers for ongoing monitoring appropriate and that the AMP complied with the requirements of the PAN. It was recommended that an environmental auditor be engaged to review future monitoring reports and assess the efficacy of the management plan and mitigation measures, as well as the need for additional contingency measures and / or determine when the site no longer presents a risk to human health (i.e. when monitoring may cease).

2.3 Assessment of Data Quality and Completeness of Works Undertaken

Based on the review of the on and off-site works undertaken it is considered that sufficient assessment has been undertaken to provide Senversa with assurance regarding the quantity (temporal and spatial) and quality of data to form an opinion on the final contamination status of the site. In Senversa’s opinion, the quality and reliability of information generated from the investigations undertaken taking into account all limitations as identified in previous sections and within the separate reports, were sufficient for the purposes of this final condition assessment. Details of the quality assurance programs are provided in the individual reports included in as part of this lodgement application.

2.4 Assessment for Need for Environmental Audit

The need for an environmental audit has been made by comparison of the historical land uses with the nature of the proposed residential (sensitive) use of the site. Comparison of the historical uses of the site to Table 1 of the Practice Note indicates that the site has a “Medium Potential” for contamination based on the ancillary nature of the limited chemical and fuel storage (above ground) carried out on the site as a part of green keeping activities. Review of the assessment matrix contained within Table 2 of the Practice Note, indicates that for sensitive uses (including residential), a “B” level of environmental assessment is required to determine the need for an environmental audit. This level of assessment consists of the following:

“B: Require a site assessment from a suitably qualified environmental professional if sufficient information is available to determine if an audit is appropriate. If advised that an audit is not required, default to C (i.e. low potential for contamination risk).”

As summarised in Section 2.1 above, a sufficient level of assessment has been undertaken at the site and based on the findings of these assessment works, no potentially unacceptable risks to human health or the environment associated with the proposed development have been identified. Senversa is of the opinion that the site is suitable for the proposed sensitive use and that a statutory environmental audit is not required at the site.
This opinion is further supported by the requirements of Ministerial Direction No. 1 which indicates that an environmental audit is not required where the identified land use does not meet the definition of 'potentially contaminated land'\(^1\). Golf course use does not meet the definition of potentially contaminated land.

Given the limited nature of impacts identified during the course of investigations at the site, it is unlikely that unidentified contamination will be encountered during development. However, as an effective strategy to manage this potential, a construction management plan identifying action should be developed to manage potential risks to human health and the environment that may arise during redevelopment.

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\(^1\) Potentially contaminated land means land used or known to have been used for industry, mining or the storage of chemicals, gas, wastes or liquid fuel (if not ancillary to another use of the land).
3.0 Conclusions

Based on the works completed Senversa is of the opinion that the site does not pose a risk to the proposed development (environmental or human health risk associated with contamination). Given the level of investigation completed and the findings of these investigations, no environmental audit is required. This opinion is supported by the following findings:

- Targeted and grid-based soil sampling has not identified any impacted soils above what is considered to be representative of regional and/or naturally occurring background concentrations (i.e. do not represent pollution sourced from the site).
- Groundwater investigation did not identify site-derived pollution or volatile concentrations that indicates a vapour intrusion risk to future land use scenarios.
- Surface water sampling did not identify any pollution above what is considered to be representative of regional and/or naturally occurring background concentrations (i.e. do not represent pollution sourced from the site).
- Landfill gas risk assessment concluded that gas migration protection measures are not considered necessary at the site.

Given the limited nature of impacts identified during the course of investigations at the site, it is unlikely that unidentified contamination will be encountered during development. However, as an effective strategy to manage this potential, a construction management plan identifying action should be developed to manage potential risks to human health and the environment that may arise during redevelopment.

These conclusions are based on the following assumptions:

- No basements or piling foundations are proposed as part of the future development without further specific risk assessment and/or gas protection measures.
- Groundwater within the upper Brighton Group aquifer is not used on-site for extractive use purposes (i.e. potable drinking water, on-site irrigation or filling of swimming pools).
- Ongoing LFG, leachate and groundwater monitoring and management is completed by the responsible authority at the former Spring Road Landfill. This includes operation, maintenance and review of performance of the gas extraction system at the former landfill until such time that the LFG and leachate no longer presents a risk to human health and the environment.
- A construction management plan be developed to detail actions required to be undertaken should unidentified contamination be encountered during the development.
- Remnant former use infrastructure should be appropriately decommissioned (i.e. TITs, grease trap, vehicle/chemical wash down areas, bunded fuel storage, workshop, pesticide/herbicide storage areas), in line with the requirements of a construction management plan.
- A water quality management plan (WQMP) should be prepared if use of surface water and/or deep groundwater (from the Silurian aquifer) for irrigation be proposed for the site. The WQMP should include details on:
  - Monitoring requirements for all surface water bodies and the Silurian aquifer to ensure surface water quality meets the maintenance of ecosystems, agriculture parks and gardens and primary contact recreation criteria.
  - Trigger levels to identify water quality problems and contingency measures should water quality monitoring indicate undesirable water quality.

Given the limited nature of impacts identified during the course of investigations at the site, it is unlikely that unidentified contamination will be encountered during development. However, as an effective strategy to manage this potential, a construction management plan identifying action should be developed to manage potential risks to human health and the environment that may arise during redevelopment.

These conclusions are based on the following assumptions:

- No basements or piling foundations are proposed as part of the future development without further specific risk assessment and/or gas protection measures.
- Groundwater within the upper Brighton Group aquifer is not used on-site for extractive use purposes (i.e. potable drinking water, on-site irrigation or filling of swimming pools).
- Ongoing LFG, leachate and groundwater monitoring and management is completed by the responsible authority at the former Spring Road Landfill. This includes operation, maintenance and review of performance of the gas extraction system at the former landfill until such time that the LFG and leachate no longer presents a risk to human health and the environment.
- A construction management plan be developed to detail actions required to be undertaken should unidentified contamination be encountered during the development.
- Remnant former use infrastructure should be appropriately decommissioned (i.e. TITs, grease trap, vehicle/chemical wash down areas, bunded fuel storage, workshop, pesticide/herbicide storage areas), in line with the requirements of a construction management plan.
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  - Monitoring requirements for all surface water bodies and the Silurian aquifer to ensure surface water quality meets the maintenance of ecosystems, agriculture parks and gardens and primary contact recreation criteria.
  - Trigger levels to identify water quality problems and contingency measures should water quality monitoring indicate undesirable water quality.
Conclusions

- All on-site monitoring bores should be decommissioned in accordance with relevant guidance, to minimise the potential for this infrastructure to act as a preferential gas migration conduit, prior to the redevelopment of the site.
Figures

Figure 1: Site Features Plan