APPENDIX F

Beneficial Uses and Assessment Criteria

1.0 SOIL

1.1 Land Beneficial Uses

The SEPP 2002 (Prevention and Management of Contamination of Land) (Land SEPP, GoV, 2002) outlines land use categories and specifies beneficial uses that are to be protected for each category.

The site operates as a training college for emergency response and incident management and will remain in this use for the foreseeable future.

The site is zoned as 'Farming Zoning' and a large portion of the Site consists of forestry, grassland paddocks and landscaped land. However, agriculture is not considered an appropriate land use category as the Site is not currently, or in the foreseeable future likely to be, used for agriculture activities. Industrial is considered an appropriate land use category due the storage and use of flammable liquids and gases during fire fighting training activities on site. It is noted that there is temporary and permanent residential housing on site. This soil sampling component of the PSA was targeted at identified Areas of Interest (i.e., potential contamination sources) within the active fire training area. The relevant beneficial uses were therefore those associated with industrial land use.

The Land SEPP (GoV, 2002) outlines indicators and objectives for land based on the protected beneficial uses for these land uses. The beneficial uses outlined in Table 1 are relevant to the Site.

Table 1: Protected Land Beneficial Uses

Beneficial Use	Industrial Land Use
Maintenance of Ecosystems	
- Natural Ecosystems	
- Modified Ecosystems	
- Highly Modified Ecosystems	✓
Human Health	✓
Buildings and Structures	✓
Aesthetics	
Production of food, flora and fibre	

1.2 Soil Assessment Criteria

Available Australian soil criteria were used to screen soil samples collected at the Site, in accordance with state and federal guidance for assessment of site contamination for protection of the environment and human health. Where generic assessment criteria were lacking in Australia, these were sourced from other jurisdictions. Criteria published by select agencies in the Netherlands, Canada and United States were considered. The agencies identified from these jurisdictions were selected because the criteria published are risk-based, the approaches and guidance used to derive the criteria follow international best practice and are documented, transparent and readily available for review. Where criteria were not readily available from other jurisdictions, risk to humans or the environment could not be assessed.

Approach to Assessment of Dioxins

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are poly-chlorinated dioxin like compounds that are considered to be structurally and toxicologically related. PCDDs are represented by up to seven isomers, while PCDFs are represented by up to ten isomers. The structural differences between each isomer, results in differences in toxicity or potency. The overall toxicity of PCDD/F mixtures is expressed using the International Toxic Equivalents (TEQ). The TEQ scheme assigns each isomer a specific Toxic Equivalency Factor (TEF) relative to the most toxic isomer (TCDD (2,3,7,8-TCDD) - which is given a value of one).

To calculate the total PCDD or PCDF TEQ of a dioxin/furan mixture, the amounts of each isomer are multiplied by the respective TEF and summed. In this report the TEQ were calculated using World Health Organisation TEF's.

Where isomers are reported at concentrations less than the LOR, there are a number of standard, accepted ways that the TEQ can be calculated for PCDD/Fs. The TEQ can be calculated by assuming that the isomers reported below the LOR are present at zero, 50% or 100% of the LOR. These give an indication of a conservative best-case to worst-case estimate of actual concentrations, respectively, of total PCDD/D TEQ. This assessment calculates the TEQ based on 50% of the LOR.

Maintenance of Ecosystems

For assessment of the beneficial uses of "modified or highly modified ecosystems", the Land SEPP (GoV, 2002) states that contamination must not adversely affect the maintenance of the relevant ecosystems. Furthermore, the level of any indicator (i.e. potential contaminant) must not be greater than:

- Any regional Ecological Investigation Level (*EIL*) developed in accordance with the National Environment Protection *(Assessment of Site Contamination)* Measure(NEPM) (1999);
- Levels derived using a risk assessment methodology described in the NEPM; and
- Levels approved by the Authority (i.e. the Victorian Environment Protection Authority, EPA).

The analytical results from the soil samples were screened against the following soil assessment criteria:

- NEPM (1999) *Soil Ecological Investigation Levels.*

The criteria outlined in the NEPM are generic and if exceeded are intended to trigger further considerations of risk to these kinds of ecosystems. The criteria are generally based on phytotoxicity. At this site the protected beneficial use categories for Maintenance of Ecosystems are "modified ecosystems" and "highly modified ecosystems", for which the NEPM EILs are considered to be conservative.

As the NEPM provides EILs for only 14 inorganic chemicals, where NEPM EILs were lacking, the COI analysed as part of this PSA and detected above the laboratory LOR have been screened against select criteria from select jurisdictions to identify COI at the Site.

TPH results from the soil samples were screened against the Canadian Council of Ministers of the Environment (CCME, 2008) – *Canada-Wide Standard for Petroleum Hydrocarbons in Soils* (Ecological and Human Health (Industrial land use)).

The analytical results for 3 & 4 methylphenol, PCDD and PCDF were screened against the following soil assessment criteria:

- 3- & 4- methylphenol (m- and p-cresol, respectively) were screened against the criterion for p-cresol[1] taken from the Dutch National Institute of Public Health and the Environment (Rijksinstitute Voor Volksgezondheid en Milieu, RIVM, Verbruggen et al., 2001) *Ecotoxicological Serious Risk Concentration (SRC_{eco});*
- PCDD and PCDF criteria taken from the Canadian Council of Ministers of the Environment (CCME, 2012) Canadian Environmental Quality Guidelines (CEQG) *Soil Quality Guidelines for the Protection of Environmental and Human Health –Industrial land use;*

No ecological soil assessment criteria for PFOA and PFOS were found during the preparation of this report.

[1] The SRC_{eco} p-cresol criterion of 2.6 mg/kg is of low reliability. The SRC_{eco} m-cresol criterion of 16 mg/kg is of medium reliability. Adoption of the p-cresol criterion to screen m- and p-cresol in soils is conservative.

Human Health

For assessment of the beneficial use "human health", the Land SEPP (GoV, 2002) states that contamination must not cause an adverse impact on human health. Furthermore, it states that the level of any indicator (i.e. potential contaminant) must not be greater than:

- The Human Health Investigation Levels (HIL) specified in the NEPM;
- Levels derived using a risk assessment methodology described in the NEPM; and
- Levels approved by the Authority (i.e. the Victorian EPA).

As Industrial considered appropriate land use categories for assessment of soil analytical results, the analytical results from the soil samples were screened against the following soil assessment criteria:

- NEPM (1999) *Assessment of Soil Contamination Measure – Schedule B(1): Soil HIL "F" (Commercial/Industrial).*

Where NEPM HILs were lacking, the COI analysed as part of this PSA and detected above the laboratory LOR have been screened against select criteria from select jurisdictions to identify COI at the Site:

- TPH criteria from CCME (2008) *Canada-Wide Standard for Petroleum Hydrocarbons in Soils*;
- 3 & 4 methylphenol (m- and p-cresol) and PCDD and PCDF criteria taken from the United States Environmental Protection Agency (US EPA, 2011) *Regional Screening Levels for soils; and,*
- PFOA & PFOS criteria taken from Minnesota Pollution Control Agency (PCA) (1999) *Soil Reference Value (SRV).*

Buildings and Structures

For assessment of the beneficial use of "buildings and structures", the Land SEPP (GoV, 2002) states that contamination must not cause the land to be corrosive to, or adversely affect the integrity of structures or building materials. The beneficial use is assessed by a review of physical parameters, including the pH of soils in accordance with Australian Standard AS2159 – 2009 *"Piling – Design and installation"*.

Application of Soil Assessment Criteria

The soil assessment criteria represent threshold concentrations below which risks for the stated exposure scenarios and to receptors are considered acceptable. It is intended that the screening criteria be compared with the assessed exposure concentrations. An exceedance does not necessarily mean that risks are unacceptable, rather it means that the cause of the exceedance and the actual level of risk posed by this exceedence, merit closer examination.

2.0 SURFACE WATER

2.1 Surface Water Beneficial Uses

The protected beneficial uses of surface water in Victoria are outlined in the SEPP (WoV, GoV, 2003) (Variation S 107).

The SEPP (GoV, 2003) classifies surface water into the following four segments:

- Aquatic Reserves Segments;
- Wetland and Lakes Segments;
- River and Stream Segments; and
  - Highlands.
  - Forests A.
  - Forests B.
  - Cleared Hills and Coastal Plains.
  - Murray and Western Plains.
- Marine and Estuarine Segments.
  - Estuarine and Inlets.
  - Open Coasts.
  - Port Philip Bay.
  - Western Port.
  - Gippsland Lakes.

Each segment has defined beneficial uses and surface water in each segment must be of a suitable quality and quantity to support the defined beneficial uses.

Lake Fiskville is located in the south western portion of the Site, and discharges into Beremboke Creek which is part of the Moorabool River Catchment. It is inferred that the eastern portion of site drains south easterly into Yaloak Creek, which is part of the Werribee River Catchment. The Moorabool and Werribee rivers are listed within the Cleared Hills and Coastal Plains Segment in the SEPP (WoV, GoV, 2003) (S 107).

The protected beneficial uses within the Cleared Hills and Coastal Plains Segment are listed in Table 2.

Table 2: Protected Surface Water Beneficial Uses

Beneficial Use	Rivers and Streams
	Cleared Hills and Coastal Plains
Aquatic Ecosystems that are slightly to moderately modified	✓
Water Suitable for:	
Primary contact recreation:	✓
Secondary contact recreation:	✓
Aesthetic Enjoyment	✓
Indigenous Cultural and Spiritual Values	✓
Non-indigenous cultural and spiritual values	✓
Agricultural and Irrigation	✓
Aquaculture	✓
Industry and Commercial Use	✓
Human Consumption	✓
Fish, crustacean & molluscs for human consumption	✓

Surface water samples were collected from Dams 1 – 4 and Lake Fiskville.

As Beremboke Creek (which is part of the Moorabool River Catchment), flows through Lake Fiskville, surface water in Lake Fiskville must be of a suitable quality and quantity to support the defined beneficial uses within the Cleared Hills and Coastal Plains Segment. The beneficial uses for Lake Fiskville listed under the Cleared Hills and Coastal Plains Segment (and identified above) are considered unlikely to be realised given the use of the Site. The beneficial uses of "aquatic ecosystems", "aesthetic enjoyment" and "contact recreation" are considered most likely to be realised at the Site and thus the water in Lake Fiskville have been assessed against these indicators and objectives.

Birds are likely to be exposed to water in Lake Fiskville. However, the ANZECC and ARMCANZ (2000) WQG for protection of aquatic life and livestock are unsuitable for screening against impacts to bird life. Consequently, assessment of impacts to birds accessing waters in Lake Fiskville is outside of the scope of this assessment. Impacts to aquatic ecology and livestock drinking water may be used as an indicative assessment of potential for impact to birds.

Dams 1 - 4 are artificial (man-made) dams which are part of the FLP waste water treatment system.

The SEPP (WoV, GoV, 2003) considers artificial water features differently to natural surface waters, as follows:

Beneficial uses are protected except:

i) in circumstances where the background level would not provide for their protection;

ii) in artificial stormwater drains, artificial agricultural drains, artificial irrigation channels and drains or artificial wetlands (see clauses 46 and 51). These artificial environments need to be managed for the purposes for which they were constructed and must be designed and managed so that they are not harmful to humans or have unacceptable impacts on animals, and so that their impact on surface waters is minimised. Although beneficial uses are not protected in these artificial environments, it is not acceptable to dump or illegally discharge wastes into them.

iii) where otherwise specified in the Policy (see clause 48).

Dams 1 - 4 are artificial environments and the beneficial uses are not protected under SEPP WoV (GoV, 2003). There is limited potential for site users (humans) to come into contact with surface water in Dams 1, 3 and 4 during accidental exposures or planned routine maintenance activities (e.g. dredging, installation of aeration pumps). Exposure to surface waters in these scenarios and would be further limited or prevented by use of appropriate personal protective equipment (PPE) e.g., waterproof clothing. Surface water in Dam 2 is used in fire fighting training exercises; therefore there is the potential for trainees and trainers to come into contact with surface water in Dam 2 during these training exercises. .

On this basis, surface water analytical results in Dams 1 - 4 have been assessed for screening purposes using drinking water criteria. Screening the dam water quality against these criteria is a very conservative approach as the criteria are based on daily consumption of 2 L of water. As these dams form part of the waste water treatment at the Site consumption of this volume of water from these dams is unlikely. More likely exposures would be associated with incidental exposures during use of water in fire training and planned, routine maintenance activities where humans may be have limited dermal exposure to dam water or ingest limited quantities of dam water. The exposure doses in these scenarios are reduced compared to the exposure doses on which the drinking water criteria are based.

A discussion of the surface water assessment criteria applied to the Site are presented below. In summary the criteria adopted include:

- Ecosystems – freshwater aquatic ecosystem trigger values for the protection of 95% of species as outlined in ANZECC and ARMCANZ (2000) WQG.
- Recreation (Primary and Secondary) and Aesthetic Enjoyment – as outlined in Guidelines for Managing Risks in Recreational Waters (NHMRC 2008).
- Agriculture and Irrigation – trigger values for irrigation water and livestock drinking as outlined in ANZECC and ARMCANZ (2000) WQG.
- Aquaculture – toxicant guidelines for the protection of aquaculture species as outlined in ANZECC and ARMCANZ (2000) WQG.
- Human Consumption – as outlined in Australian Drinking Water Guidelines (NHMRC and NRMMC 2004).
- Fish, crustacean and molluscs for human consumption – toxicant guidelines for the protection of aquaculture species as outlined in ANZECC and ARMCANZ (2000) WQG.

Aquatic Ecosystems

The Moorabool River and Werribee River are listed within the Cleared Hills and Coastal Plains Segment in the SEPP (WoV, GoV, 2003) (S 107). The SEPP (GoV, 2003) states that the aquatic ecosystems to be protected under the Cleared Hills and Coastal Plains Segment are “slightly to moderately modified ecosystems”. Therefore, freshwater aquatic ecosystem trigger values for the protection of 95% of species in ANZECC and ARMCANZ (2000) WQG have been adopted for assessment of the protection of aquatic ecosystems.

Recreation & Aesthetic Enjoyment

The aim of the NHMRC (2008) Guidelines for Managing Risks in Recreational Waters is to ‘*protect human health during recreational activities in surface water and to preserve the aesthetic appeal of water bodies’*. Therefore these guidelines have been adopted for assessment of the protection of Recreation and Aesthetic Enjoyment.

The NHMRC (2008) guidelines refer to raw water for drinking and aesthetic purposes for toxicants, as provided in the Australian Drinking Water Guidelines (NHMRC and NRMMC, 2004).

However it is noted in NHMRC (2008) that:

"All guideline values listed in Table 9.1 are applicable to drinking water quality and are based on the daily consumption of 2 L. These values should only be used as a guide to deriving chemical values applicable to recreational water bodies. Using a consumption factor of 2 L will result in very conservative health guideline values in recreational water. When applying these values to recreational water exposure, consumption of 100–200 mL per day should be taken into consideration."

Given the above statement from NHMRC (2008), the difference between the volume of water consumed as drinking water and the volume consumed during recreational activities equates to a potential increase in the drinking water criteria of 10 fold for inorganic chemicals[2], taking other pathways into account. Therefore the adopted criteria are considered conservative for inorganic chemicals.

Agriculture and Irrigation

The ANZECC and ARMCANZ (2000) WQG irrigation water long term trigger values (LTV) have been adopted to protect the beneficial use of irrigation. The irrigation LTV is defined as maximum concentration (mg/L) of contaminant in the irrigation water which can be tolerated assuming 100 years of irrigation, based on the irrigation loading assumptions. The LTV value has been developed to minimise the build-up of contaminants in surface soils during the period of irrigation and to prevent the direct toxicity of contaminants in irrigation waters to standing crops. The ANZECC and ARMCANZ (2000) WQG recommended water quality trigger values (low risk) for heavy metals and metalloids in livestock drinking water are adopted to protect the beneficial use of agriculture.

Aquaculture and Fish, crustacean and molluscs for Human Consumption

The ANZECC and ARMCANZ (2000) WQG toxicant guidelines for the protection of aquaculture species have been adopted to assess the impacts on beneficial use of aquaculture and fish, crustacean and molluscs for human consumption.

Human Consumption

The Australian Drinking Water Guidelines (NHMRC and NRMMC, 2004) *for drinking water, aesthetics and pesticides* have been adopted for assessment of the protection of beneficial use of human consumption of surface water.

Industrial Water Use

The ANZECC and ARMCANZ (2000) WQG states that the Guidelines provide no specific guidelines for industrial water use because industrial water requirements are so varied. Therefore for this PSA an assessment of surface water quality for the beneficial use of industrial water will be undertaken through consideration impacts to other beneficial uses.

Other Assessment Criteria

Where Australian criteria were lacking, the COI analysed as part of this PSA and detected above the laboratory LOR have been screened against select international risk-based assessment criteria to screen COI at the Site. Criteria published by agencies in the Netherlands, Canada and United States were considered. These jurisdictions were selected because the criteria are risk-based, the approaches, guidance used to derive the criteria follow international best practice and are documented, transparent and readily available for review.

- TPH criteria from WHO 2008 *Petroleum products in drinking-water. Background document for development of WHO Guidelines for drinking-water quality*. Geneva, World Health Organisation (WHO/SDE/WSH/05.08/123)PFOS/PFOA criteria from Dutch RIVM (Verbruggen et al., 2001) *Ecotoxicological Serious Risk Concentration (SRC_{eco});*
- PFOS/PFOA criteria from US EPA (2009) *Provisional Health Advisory Levels (HAL)*

[2] Drinking water guidelines may be increased by a factor of 10 for specific chemicals where ingestion whilst swimming is likely to be the most significant exposure route. For some chemicals, such as organics, exposure via dermal absorption and inhalation of volatiles may also be significant. For these chemicals, application of default multipliers to the guidelines is not appropriate.

Application of Surface Water Assessment Criteria

As surface water Lake Fiskville must be of a suitable quality and quantity to support the defined beneficial uses within the Cleared Hills and Coastal Plains Segment, the surface water analytical results from Lake Fiskville have been compared to the assessment criteria outlined above.

3.0 SEDIMENT ASSESSMENT CRITERIA

Sediment samples were collected from Dams 1 – 4 and Lake Fiskville. The protected beneficial uses of sediments in surface waters in Victoria are captured in the SEPP (WoV, GoV, 2003) (Variation S 107).

Dams 1 - 4 are artificial water bodies, and are part of the FLP waste water treatment system, the beneficial uses protected under SEPP WoV (GoV, 2003) are not considered applicable. There is the potential for site users to come into contact with sediment in Dams 1 – 4 as a consequence of accidental exposures, or during planned, routine maintenance activities (e.g. dredging, installing aeration pumps). Noting that humans undertaking planned maintenance activities, are likely to be wearing appropriate personal protective equipment (PPE) which will further limit the likelihood for exposure. On this basis, sediments in Dams 1-4 had been assessed for the potential impact on human health.

Beremboke Creek flows through Lake Fiskville thus sediments in Lake Fiskville must be of a suitable quality and quantity to support the defined beneficial uses within the Cleared Hills and Coastal Plains Segment. The beneficial uses for Lake Fiskville listed under the Cleared Hills and Coastal Plains Segment (and identified above) are considered unlikely to be realised given the use of the Site. The beneficial uses of "maintenance of aquatic ecosystems", "human health" and "aesthetics" are considered most likely to be realised at the Site. The water in Lake Fiskville has been assessed against these indicators and objectives.

3.1 Maintenance of Ecosystems

The Lake Fiskville sediment data have been screened using available Australian sediment criteria. Screening the sediment against available sediment criteria will identify where chemical concentrations are elevated and may pose impacts to aquatic ecosystems of Lake Fiskville.

To assess protection of the beneficial use of "modified or highly modified ecosystems", the sediment results from Lake Fiskville (SD1 & SD2) were screened against the following sediment assessment criteria:

- ANZECC and ARMCANZ (2000) WQG *Interim Sediment Quality Guidelines* (*ISQG*) *low and high.*

These assessment criteria are trigger values that may prompt further action if exceeded. Further action may include management or remedial action or further investigation to consider the fraction of the contaminant that is bioavailable or can be transformed and mobilised in a bioavailable form.

Where Australian criteria were lacking, the COI analysed as part of this PSA and detected above the laboratory LOR have been screened against select international risk-based assessment criteria to screen COI at the Site. Criteria published by agencies in the Netherlands, Canada and United States were considered. These jurisdictions were selected because the criteria are risk-based, the approaches, guidance used to derive the criteria follow international best practice and are documented, transparent and readily available for review.

- PCDD and PCDF criteria from CCME (2012) CEQG *Sediment Quality Guidelines for the Protection of Aquatic Life;*

No sediment ecological assessment criteria for PFOA and PFOS were found during the preparation of this report.

3.2 Human Health

There are no guidelines in Australia and no readily available guidelines in other jurisdictions for screening impacts to humans from sediments. In the absence of sediment guidelines protective of humans, screening against available soil guidelines is considered appropriate. Thus, the sediment results were screened against the same assessment criteria as identified in Section 1.

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