Attachment A – Studley Park Gum survey report
This publication is prepared in response to consultation with DELWP to consider the impact of the North East Link (project boundary) on the Studley Park Gum. This publication may be of assistance to the reader but the North East Link Project (a division of the Major Transport Infrastructure Authority) and its employees, contractors or consultants (including the issuer of this report) do not guarantee that the publication is without any defect, error or omission of any kind or is appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this publication.
Executive summary

Studley Park Gum (*Eucalyptus x studleyensis*) is a hybrid taxon between River Red Gum (*E. camaldulensis*) and Swamp Gum (*E. ovata*). Most records are concentrated within the metropolitan area to the north and north-east of Melbourne where it primarily occurs along the lower Yarra River corridor north-east of Melbourne. Studley Park Gum is not listed under the Victorian Flora and Fauna Guarantee Act 1988 (FFG Act) or the Environment Protection and Biodiversity Conservation Act 1999 (EPBC). It is a *Eucalyptus* hybrid recognised by the National Herbarium of Victoria. It is described as endangered on an advisory list in Victoria (DEPI 2014).

During vegetation surveys conducted in 2017 and 2018 as part of the North East Link EES Ecology Technical Report, a number of Studley Park Gum trees were identified and mapped in the North East Link project boundary at Simpson Barracks. Several others were identified outside the project boundary but they are not the focus of the survey reported here.

To clearly articulate the likely impacts of North East Link on Studley Park Gum within the project boundary, a survey of Studley Park Gum was conducted in May 2019. The survey was conducted within the NEL project boundary at Simpson Barracks. Information collected included tree location, size and condition. Since the taxon is a hybrid and difficult to distinguish in the field, a reference set of photographs was compiled from herbarium specimens and a number of trees from known locations were inspected prior to the survey. Identity was confirmed for a representative set of specimens collected during the survey by the National Herbarium of Victoria.

The survey found 43 Studley Park Gum trees within the project boundary at Simpson Barracks. Of these 72% were identified with a moderate to high degree of confidence. Trees varied in size from 5 to 158 cm diameter at breast height (DBH), the majority of which were in good condition. Most trees recorded were in the intermediate size class suggesting a period of recruitment had occurred at some time in the relatively recent past.

This report is limited to a survey so as to provide a basis to inform the preparation of a management plan in association with the North East link project. Because it is a hybrid taxon, and because seed from parent taxa can readily be collected and stored, there is potential for propagation and planting.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.6 and the assumptions and qualifications contained throughout the report.
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Appendix A – Herbarium specimens examined
1. Introduction

1.1 Description

Studley Park Gum (*Eucalyptus x studleyensis*) is a hybrid taxon between River Red Gum (*E. camaldulensis*) and Swamp Gum (*E. ovata*). It is a named intersectional *Eucalyptus* hybrid formally recognised by the National Herbarium of Victoria.

Leaf, bud and fruit character traits are intermediate between the two parent taxa but may vary morphologically and align more closely with one species or the other (VicFlora 2016).

1.2 Distribution

Studley Park Gum is known to occur along the lower Yarra River corridor north-east of Melbourne (e.g. Kew, Ivanhoe, Viewbank, Rosanna, Macleod, Yallambie, Watsonia). Almost all records are concentrated within the metropolitan area to the north and north-east of Melbourne; however, two reliably determined specimens are also known from Nar Nar Goon south-east of Melbourne and at Connewarre on the Bellarine Peninsula. Site records in the Victorian Biodiversity Atlas, herbarium records and field observations (K. Rule, pers. comm.; D. Cameron, DELWP, pers. comm.) indicate the taxon also occurs near Clayton North, at Lysterfield Park and between Carrum Downs, Hampton Park and Lyndhurst to the south-east of Melbourne, and at Riddells Creek to the north-west of Melbourne (Figure 1).

During vegetation surveys that were conducted in 2017 and 2018 as part of the North East Link EES Ecology Technical Report, a number of Studley Park Gum trees were identified and mapped within the North East Link project boundary at Simpson Barracks.

1.3 Conservation significance

Studley Park Gum has the following Commonwealth and Victorian listing status:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* – not listed
- Advisory List of Rare or Threatened Plants in Victoria 2014 (DEPI 2014) – endangered.

Studley Park Gum is considered a well-established and fertile hybrid taxon with a relatively restricted distribution across Victoria. Extant populations are likely to represent complex hybrid swarms with numerous back crosses to one another of its parents, or segregates resulting from self-pollination (Sharkey 1998, cited in Cameron *et al.*, 1999). The vast majority of stands and the largest populations are confined to the Watsonia, Yallambie, Viewbank and Rosanna area, and are deemed botanically significant in the region.

Experts consider that the evolutionary aspects of the taxon are also of significance, for their potential contribution to evolutionary novelty and speciation if they are also fertile and form hybrid swarms in the wild. Cameron *et al.*, (1999) argue that *E. x studleyensis* has scientific and evolutionary significance, with a high potential to contribute to the evolution of new species. Their reasoning for this statement is that the hybrid is fertile, there is a high genetic difference between the parents, the hybrid has a high level of character stabilisation and is present in distinct swarms, and that it displays niche differentiation from the parent species.
Because *Eucalyptus x studleyensis* combines all these qualifying characteristics it is reasonable to assess it as threatened on account of its potential contribution to speciation (Cameron *et al*., 1999).

### 1.4 Previous studies

The most detailed information with respect to the distribution and habitat of Studley Park Gum is from Opie *et al*. (1997) and Cameron *et al*. (1999).

Opie *et al*. (1997, cited in Cameron *et al*. 1999) conducted a botanical survey of two broad areas – Simpson Barracks and adjacent properties to the north east of the Barracks, known as the Streeton Estate. At that time, Studley Park Gum occurred throughout the surveyed area, and was co-dominant with Yellow Box (*E. melliodora*) in one part of the now developed area (Opie *et al*. 1997 cited in Cameron *et al*. 1999).

Following Opie *et al*’s work, Cameron *et al*. (1999) conducted a botanical survey to the immediate east of Simpson Barracks, in the Streeton Views Estate. As part of the work, and to gain contextual information on the taxon’s distribution, 28 sites were visited where Studley Park Gum had been previously recorded. These were ranked according to their order of significance for conservation. The authors concluded that the remaining stands of Studley Park Gum in the Yallambie-Macleod-Rosanna area were most likely remnants of a formerly more widespread and interconnected population, since fragmented by urban development.

In their report, Cameron *et al*. (1999) considered that Simpson Barracks supported “the largest and most extensive, and possibly also the most secure, hybrid swarm of *Eucalyptus X studleyensis* known to us, including at least 53 established trees and numerous juveniles.” At the time of the report, the Studley Park Gum population immediately to the east of the Greensborough Road site was thought to be the best of only three known populations that were assumed to be ecologically viable.

Two other populations located near the Simpson Army Barracks, in the Commonwealth Military Reserve Area and the adjacent transmission line easement, and in the Streeton Views Estate Stage 11 in Yallambie, were also considered highly significant. Around 117 hybrid individuals of varying age and size classes were noted in these areas by Cameron *et al*. (1999).

Other sites recorded by Cameron *et al*. (1999) included Plenty Hospital at Macleod, and a further 11 sites in Kew, Lower Plenty, Yallambie, Rosanna, Heidelberg, Ivanhoe and Eaglemont. Populations at these sites were variously described as ‘highly introgressed’ hybrids or lacking any opportunity to recruit owing to a loss of ‘natural ecological processes’.

### 1.5 Purpose of this report

The primary purpose of this report is to articulate the likely impacts of North East Link on Studley Park Gum within the project boundary. Consequently, we aimed to estimate the number, condition and size range of Studley Park Gum trees within the North East Link project boundary at Simpson Barracks.

### 1.6 Limitations

Limitations to the survey included the following:

- Only reproductively mature trees were able to be identified with a high level of confidence, since identification relies on the presence of a range of characters, including buds, fruits, leaves and well developed bark. To obtain a high degree of confidence in identification, at least three of the above characters needed to fit well with the description of Studley Park Gum.
• Immature (non-reproductive trees) were generally assigned an identification confidence of poor or moderate, or not determined, since these trees generally lack buds or fruit and well developed bark.

• Identified trees outside the project boundary were excluded.

1.7 Assumptions

The area referred to as Simpson Barracks includes publicly accessible Commonwealth Land to the south of the barracks.

Trees with greater than 10% of their Tree Protection Zone within the project boundary were considered potentially lost as a result of construction.
North East Link Project

Distribution of Studley Park Gum Records within the Victorian Biodiversity Atlas

Figure 1

Job Number: 31-35006
Revision: D
Date: 14 Jun 2019

- Records pre 1980
- Records post 1980
- ESS project boundary

Legend

North East Link Project

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Data Sources: Data Set Name - Custodian - Version/Date. Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, USGS, FAO, NPS, NRO, N elevations, Hydrology, GeoEye, Getmapping,vision, i-cubed, Intermap, NGA, USGS, GTOPO30, USGS, Avenza Systems, Inc., British Crown Copyright (2018), Met Office, NERC, NERC, BGS, SoM, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community.
2. Methods

The following approach was proposed to develop a framework to estimate the number of Studley Park Gum trees within the project boundary at Simpson Barracks.

2.1 Taxon determination

Studley Park Gum is notoriously difficult to identify, and consequently, is frequently misidentified, even by experienced botanists. The Flora of Victoria contains little descriptive information for Studley Park Gum, which is known to be morphologically variable, particularly with respect to bud, fruit, leaf and bark characteristics. To provide an overview of potential variation within the Studley Park Gum complex and to assist with identification of the species in the field, the following steps were undertaken prior to formally commencing the field survey:

- All curated specimens of Studley Park Gum held at the National Herbarium of Victoria, Royal Botanic Gardens (hereafter referred to as ‘MEL’) were examined on 30 April 2019.
- A photographic reference set of characteristics was compiled from all curated specimens and from photographs taken during the earlier survey (Plate 1). Photographs included leaves, fertile material, location description and MEL reference number (Appendix A). This reference set was carried in the field by each team.
- A total of five publicly accessible locations where Studley Park Gum was known to occur (based on herbarium records) were visited on 1 May 2019 prior to conducting the survey at Simpson Barracks. Photos and plant material of the species were collected at each location to confirm the species identification and to use as reference material during the survey. The sites visited were in Viewbank, Macleod, Watsonia, Heidelberg and Eaglemont.
- A review of Cameron et al. (1999) and a comparison of sites listed in this report with curated specimens held at MEL.

2.2 Field survey method

To locate all potential stands, treed areas in Simpson Barracks within the project boundary were systematically surveyed by following pre-determined parallel transects at 15 m intervals (i.e. line of sight of 7.5 m either side of the transect walked), guided by aerial imagery on mobile technology. The area of Commonwealth land south of the Simpson Barracks boundary, was also surveyed using the transect approach. The survey aimed to cover the equivalent of a distance of 8 km within the 10.976 ha area of treed vegetation within the project boundary at Simpson Barracks (Figure 2).
2.2.1 Data collection and management

The following information was collected for each Studley Park Gum surveyed:

- Tree location (geographic co-ordinate)
- Tree size (diameter at breast height) assigned to size classes:
  - 5-25 cm
  - 25-80 cm
  - >80 cm, i.e. trees defined as ‘large trees’ according to the relevant Ecological Vegetation Class benchmark
- Identification confidence:
  - High: buds, fruits and well-developed rough bark at base of trunk present, with buds and fruits generally intermediate between *E. ovata* and *E. camaldulensis*. Intermediate leaves present
  - Moderate: reproductive material scarce, or only buds or fruit present; well-developed rough bark at base of trunk present. Leaves generally intermediate
  - Poor: no reproductive material observed, but well developed rough bark at base of trunk usually present. Leaves varying in morphology along a continuum between the two parent species.
- Notes/comments with respect to diagnostic characteristics
- Tree condition:
  - Good: More than 70% of the crown present with no evidence of dieback, although damage from non-biological sources may be evident (e.g. wind)
  - Moderate: 30-70% of the crown present, may be some evidence of dieback as a consequence of pathogens, insect attack or drought stress, and may be damage from non-biological sources
  - Poor: Less than 30% of crown remaining, with tree suffering from significant dieback as a consequence of pathogens, insect attack or drought stress, or displaying evidence of significant damage causing permanent loss of branches
- The trunk of each tree within Simpson Barracks was marked with numbered tags commonly used by arborists (aluminium tags and nails) at about 1.5 m from the ground
- Georeferenced photographs of each tree (close-up of tag, entire tree and if considered useful crown, fruits, buds, bark and leaves).

Representative specimens were lodged as vouchers with the National Herbarium of Victoria on 16 May 2019.

Data were captured using Collector for ArcGIS on mobile technology and exported to Excel.

2.2.2 Personnel and timing

Fieldwork at Simpson Barracks was conducted between 1-3 May 2019 by two teams of botanists, with each team led by a principal botanist/senior botanist with over 20 years of experience, and accompanied by a botanist. Staff were rotated between teams to maximise consistency, and both lead botanists were together in the field on the first day, to minimise the potential for ambiguity in interpretation of character traits of the taxon.

2.3 Groundwater drawdown

The construction of the North East Link northern tunnel portal has the potential to impact Studley Park Gum trees outside the project boundary, owing to the possibility of groundwater

For the purpose of this assessment, the potential indirect impacts of groundwater drawdown on large (i.e. >80 cm DBH) Studley Park Gum trees were assessed.
Plate 1  Comparison of fruit morphology, *E. camaldulensis* (left), *E. x studleyensis* (centre) and *E. ovata* (right)
3. Results

3.1 Taxon confirmation

Specimens that were re-located from herbarium records, as well as one additional tree (Interlaken Parade, Rosanna), were confirmed as correct by the National Herbarium of Victoria (Table 1).

However, there was one exception where a specimen from Banyule Flats lodged with MEL is likely to be misidentified as *E. x studleyensis* (N. Walsh, MEL, pers. comm.). After examination of a freshly collected specimen, the tree was considered more likely to be *E. trabutii* (MEL 2394829), which is a hybrid of cultivation between *E. botryoides* and *E. camaldulensis*, *fide* L.D.Pryor & L.A.S.Johnson (Flora of Australia 1988). The curated specimen is also likely to be mis-identified (N. Walsh, MEL, pers. comm.).

There were a number of curated specimens collected from Simpson Barracks; however, none of these included precise locations and consequently, were unable to be re-located with any degree of confidence.

The identity of about 15 Studley Park Gum specimens collected from Simpson Barracks within the project boundary on 1 and 2 May 2019 were confirmed and lodged with MEL on 16 May 2019.
### Table 1  Studley Park Gum specimens previously lodged with MEL and reassessed during the current survey

<table>
<thead>
<tr>
<th>Reference</th>
<th>Location</th>
<th>Re-located</th>
<th>Voucher lodged</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEL 2330324</td>
<td>Corner of Henderson’s Rd and Martin’s Lane, Viewbank (1998)</td>
<td>1 May 2019</td>
<td>16 May 2019</td>
<td>Epicormic growth with buds; leaves broad and wavy; rough flaky bark at base to 2 m; valves on fruit shortly exerted.</td>
</tr>
<tr>
<td>MEL 2330327</td>
<td>Aminya Reserve, Watsonia (1997)</td>
<td>1 May 2019</td>
<td>16 May 2019</td>
<td>Bark, leaves and buds closer to <em>E. ovata</em>; fruits toward <em>E. camaldulensis</em>; valves exerted; healthy tree to 20 m high.</td>
</tr>
<tr>
<td>MEL 2394829</td>
<td>Banyule Flats Reserve, Heidelberg (2016)</td>
<td>1 May 2019</td>
<td>16 May 2019</td>
<td>Curated specimen probably mis-identified; likely to be <em>E. trabutii</em>.</td>
</tr>
<tr>
<td>MEL 1331178</td>
<td>Eaglemont Station, Eaglemont (1997)</td>
<td>1 May 2019</td>
<td>16 May 2019</td>
<td>Single tree to 22 m high; bark somewhat rough at base; leaves somewhat broader than <em>E. camaldulensis</em>; fruits not entirely cup-shaped; valves somewhat exerted; buds midway between <em>E. camaldulensis</em> and <em>E. ovata</em>; operculum rostrate but bud not as bulbous as <em>E. camaldulensis</em>; intermediate in all four characters between parent species.</td>
</tr>
<tr>
<td>MEL 707069</td>
<td>Norris Reserve (Studley Park), Kew (1945)</td>
<td>15 May 2019</td>
<td>Held at GHD</td>
<td>Four large trees in very good condition. Bark barely rough to 2 m, leaves broad lanceolate and quite wavy, buds and fruit intermediate between parent species.</td>
</tr>
<tr>
<td>K. Rule (pers. comm.)</td>
<td>Corner of Interlaken Parade and Lower Plenty Rd, Macleod</td>
<td>1 May 2019</td>
<td>16 May 2019</td>
<td>Large, healthy tree to 25 m high surrounded by buildings and roads; leaves slightly wavy; buds and fruits more aligned with <em>E. camaldulensis</em>.</td>
</tr>
</tbody>
</table>
3.2 Appropriateness of survey method

The method used to identify, re-locate and survey both known and unknown Studley Park Gum stands/trees was deemed to be effective in positively identifying the taxon and in estimating the number of trees present within the area surveyed. The inspection of curated specimens and then re-locating known records proved to be an effective approach to identifying trees and ‘tuning in’ to character traits, as well as gaining an overview of habitat preferences. Of particular interest, was the re-location of trees that are now known to have occupied the same site for up to 75 years within a metropolitan setting, e.g. Norris Reserve, Kew.

In Simpson Barracks, the entire area of 11 ha was surveyed within the project boundary, effectively providing a census of Studley Park Gum in this area, including the range of tree sizes and canopy condition. Condition classes were readily applicable in the field and sufficiently covered observed variation in tree health.

3.3 Habitat

Within the area of investigation, Studley Park Gum generally occurs on low relief mid to lower slopes on a range of aspects but generally west to south-east aspects. Based on the sites assessed for this study, in more fertile areas it only appears to occur in minor drainage lines and not on alluvial floodplain sediments. Herbarium records, VBA records and Cameron et al. (1999) indicate that the taxon may have occupied mid to upper slopes in some areas, e.g. Aminya Reserve, Watsonia.

In Simpson Barracks, Studley Park Gum was sub-dominant to *E. camaldulensis* on low relief mid to lower slopes in Plains Grassy Woodland east of Greensborough Road.

Relatively low numbers of *E. ovata* were observed during the survey but in most cases a single individual or a small number of mature individuals were in reasonably close proximity to Studley Park Gum trees.

3.4 Population census

In total, 43 Studley Park Gum trees were recorded during the survey (Table 2). Of these, 31 (72%) were identified with high to moderate confidence (Figure 3).

| Table 2 Number of trees according to identification confidence, May 2019 |
|-------------------------------|-------|------|------|
|                              | High  | Moderate | Poor |
| Number of trees              | 18    | 13    | 12   |
| Total number of trees        | 43    |       |      |

Overall, 89% of Studley Park Gum trees were in good condition throughout the area surveyed (Table 3).

| Table 3 Number of trees according to condition, May 2019 |
|-----------------------------------------------|-------|------|------|
| Numbers of trees                              | Good  | Moderate | Poor | Not assessed |
| Proportion of trees                           | 89%   | 5.5%  | 5.5% | NA           |
| Total number trees                            | 43    |       |      |
The number of trees according to size class is presented in Table 4. The bulk of trees were in the intermediate (25-80 cm DBH) size class; however, equal numbers were also present as large trees and smaller trees, indicating continuous recruitment.

**Table 4  Number of trees according to size class, May 2019**

<table>
<thead>
<tr>
<th></th>
<th>5 – 25 cm</th>
<th>25-80 cm</th>
<th>&gt;80 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Numbers of trees</strong></td>
<td>9</td>
<td>26</td>
<td>8</td>
</tr>
<tr>
<td><strong>Proportion of trees</strong></td>
<td>21%</td>
<td>60%</td>
<td>19%</td>
</tr>
<tr>
<td><strong>Total number of trees</strong></td>
<td></td>
<td>43</td>
<td></td>
</tr>
</tbody>
</table>
3.5 **Groundwater drawdown impacts**

Based on the groundwater depth and drawdown modelling presented in the EES Ecology Technical Report, two large Studley Park Gum trees outside the project boundary have a moderate likelihood of suffering premature mortality or condition decline under the 2024 construction scenario. Under the 2075 operational scenario, three large Studley Park Gum trees outside the project boundary have a high or moderate likelihood of suffering premature mortality or condition decline, owing to construction of the northern tunnel portal.
4. Discussion

4.1 Identification and limitations

Diagnostic characters were variable across the study area (Plate 2, Plate 3). Many trees recorded during the survey had character traits that were clearly intermediate between *E. camaldulensis* and *E. ovata*, and were consequently identified as *E. x studleyensis* with a high degree of confidence. However, there were also many individuals that exhibited character traits anywhere along the continuum of genuine *E. camaldulensis* through to genuine *E. ovata*.

Some individuals were very much aligned with *E. camaldulensis*, particularly with respect to fruit morphology. In the most ‘typical’ examples buds were slightly rostrate (‘pointy’) but less so than *E. camaldulensis*, and less diamond shaped as in *E. ovata*. In many cases, *E. camaldulensis* buds on young trees with no fruit were about to burst prior to flowering and at times were difficult to identify with confidence on young trees.

Fruits most readily identified as belonging to Studley Park Gum were narrowly cup-shaped, with a more or less flat disc and shortly exerted valves, in comparison to *E. camaldulensis*, which has more rounded fruits and prominently exerted valves. In comparison, *E ovata* fruits are straight sided and conical in outline with barely exerted valves. However, fruits from herbarium specimens and from other known records could also closely resemble *E. camaldulensis*, inferring that backcrosses with *E. camaldulensis* may be common. Individuals with characters more closely aligned with *E. ovata* were generally easier to identify.

Bark was also variable but generally provided a reasonably good overall impression in the majority of high confidence cases. Bark tended to be rough and almost box-like on the lower trunk to about 1-4 m depending on age, then smooth (gum-barked) above and often not as ribbony as *E. camaldulensis* or as rough as *E. ovata*. However, trees showed a good deal of variation in bark characteristics ranging from smooth trunked, to bark extending to lower branches (Plate 3).

Leaves were also variable, especially with tree age. In some trees, particularly in the northern project boundary within Simpson Barracks, leaves were broad, dark green and somewhat wavy as in *E. ovata*. Nevertheless, most specimens recorded tended to have some degree of leaf undulation and were generally broad lanceolate in shape, although some of these could be relatively thinly textured.

Saplings and youngish trees were very difficult if not impossible to identify, given the absence of reproductive material, lack of developed bark and an immature crown. Therefore, the population size of juvenile trees was unable to be determined.
Plate 2  Variation in Studley Park Gum buds and fruits
Plate 3  Variation in Studley Park Gum canopies and bark
4.2 Habitat preferences and population ecology

Studley Park Gum in the study area is generally confined to grassy open forest on low relief, mid to lower slopes, a site position also observed at Studley Park by K Cameron in 1945 – “…on a gentle slope, only four trees growing in a group surrounded by Euc. [sic.] melliodora”. The distribution of trees on the relatively less exposed aspects implies that soil moisture is a likely correlate of Studley Park Gum. The taxon appears to be absent from wet or waterlogged soils.

The mature Studley Park Gum trees within the project boundary were interspersed with saplings that could not be confidently identified as the hybrid taxon. The number of trees identified with a high degree of confidence within the project boundary suggests that this area is likely to represent a hybrid swarm. It is beyond the scope of this report to address genetic aspects but the range of size classes recorded within the project boundary suggests that hybridisation may be actively occurring in this area. Field observations also suggested that back crossing to E. camaldulensis is likely to be occurring within Simpson Barracks and has occurred in the past. Evidence for this is mainly derived from the fruits of some mature trees that are clearly more aligned with E. camaldulensis, for example, the large tree on the corner of Interlaken Parade and Lower Plenty Road.

The large number of trees in the intermediate size class also suggests that a period of relatively high levels of recruitment has occurred at some time in the past, possibly in response to cessation of vegetation clearing at Simpson Barracks at the end of the Second World War.

4.3 Current distribution within the project boundary

The survey recorded 43 trees within the project boundary at Simpson Barracks. The majority of trees were in good condition and the population comprised trees varying in size from immature saplings to mature large trees with a girth of over 1 m.

The range of size classes within the project boundary at Simpson Barracks suggest that Studley Park Gum is continuously regenerating. Cameron et al. (1999) identified a loss of ‘natural ecological processes’ that are necessary to promote regeneration of hybrid populations and retain population viability, as a key threatening process for Studley Park Gum. Of potential concern for the taxon’s persistence is a reduction in the area and quality of suitable habitat in future.

The quantity of Studley Park Gum regeneration within Simpson Barracks was unable to be determined owing to a lack of diagnostic characters in younger trees. However, it is reasonable to expect that the extent of recruitment is likely to be proportional to the number of sites where both parent species co-occur in close proximity, and where active management of the ground layer via slashing or mowing is not occurring.

4.4 Conclusions

The survey results demonstrated that Studley Park Gum was morphologically variable but the majority of trees were identified with moderate to high confidence.

The survey recorded 43 Studley Park Gum in the project boundary at Simpson Barracks. This number does not account for saplings and small trees within Simpson Barracks, which were unable to be positively identified, owing to a lack of reproductive material. The majority of Studley Park Gum within Simpson Barracks are in good condition.

Groundwater drawdown associated with the construction of the northern tunnel portal is unlikely to have a major effect on Studley Park Gum in areas outside the project boundary. Depending on the modelling scenario used, one (post-EES modelling) to three (EES modelling) additional large Studley Park Gum trees are likely to suffer premature mortality or condition decline, under the long-term 2075 operational scenario.
Studley Park Gum that are classified as large trees and impacted by the project would be offset in accordance with DELWPs *Guidelines for the removal, destruction or lopping of native vegetation*.

Seed collection is currently underway as an *ex situ* measure that may conserve part of the population’s genetic diversity off-site (C. Miller, Emerge Associates, pers. comm.). With respect to *in situ* measures to potentially avoid or minimise the loss of trees on-site, mapping the distribution of *E. ovata* is recommended to design a cross-pollination program should it be required, and post-construction monitoring of the remaining population is recommended. Propagation and replanting of the taxon is considered to be potentially achievable. The development of an appropriate management plan is recommended.
5. References


Opie, J. E., Chesterfield, E. A. and Wright, G. 1997. Environmental management Plan for Title Volume 10242 Folio 801 The property known as Stage !! on PS321038J, Streeton Views Estate, Yallambie Road, Yallambie. Prepared for Consulnet Pty Ltd


Appendices
Appendix A – Herbarium specimens examined
<table>
<thead>
<tr>
<th>MEL number</th>
<th>Date</th>
<th>Location</th>
<th>Re-located</th>
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</thead>
<tbody>
<tr>
<td>MEL 1612458</td>
<td>c. 1945</td>
<td>Studley Park</td>
<td>15 May 2019</td>
</tr>
<tr>
<td>MEL 1615756</td>
<td>1952?</td>
<td>Studley Park</td>
<td>N/15 May 2019</td>
</tr>
<tr>
<td>MEL 2012042</td>
<td>1991</td>
<td>Wantirna</td>
<td>N/A</td>
</tr>
<tr>
<td>MEL 2324453</td>
<td>1997</td>
<td>Cultivated, Watsonia Army Barracks</td>
<td>N/A</td>
</tr>
<tr>
<td>MEL 2330324</td>
<td>1998</td>
<td>Corner of Henderson’s Rd and Martin’s Lane, Viewbank (1998)</td>
<td>1 May 2019</td>
</tr>
<tr>
<td>MEL 2330624</td>
<td>Undated</td>
<td>Conneware</td>
<td>N/A</td>
</tr>
<tr>
<td>MEL 2331176</td>
<td>1997</td>
<td>Watsonia Army Barracks (no precise location)</td>
<td>N/A</td>
</tr>
<tr>
<td>MEL 2331184</td>
<td>1997</td>
<td>Watsonia Army Barracks (no precise location)</td>
<td>N/A</td>
</tr>
<tr>
<td>MEL 2375627</td>
<td>2006</td>
<td>Bonnybrook (sic.)</td>
<td>N/A</td>
</tr>
<tr>
<td>MEL 2394829</td>
<td>2016</td>
<td>Banyule Flats Reserve, Heidelberg (2016)</td>
<td>1 May 2019 (E. trabutil)</td>
</tr>
<tr>
<td>MEL 707067</td>
<td>1952</td>
<td>Studley Park</td>
<td>15 May 2019</td>
</tr>
<tr>
<td>MEL 707068</td>
<td>1945</td>
<td>Studley Park</td>
<td>15 May 2019</td>
</tr>
<tr>
<td>MEL 707069</td>
<td>c. 1945</td>
<td>Norris Reserve (Studley Park), Kew</td>
<td>N/A</td>
</tr>
<tr>
<td>MEL 707070</td>
<td>c. 1945</td>
<td>Studley Park</td>
<td>15 May 2019</td>
</tr>
<tr>
<td>Not recorded</td>
<td>2010</td>
<td>Nar Nar Goon</td>
<td>N/A</td>
</tr>
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</table>
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#### Document Status

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<th>Author</th>
<th>Reviewer</th>
<th>Approved for issue</th>
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<tr>
<td>A – for DELWP</td>
<td>T Wills</td>
<td>K Aldous</td>
<td>M Roser</td>
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Attachment B – Updated Studley Park Gum survey results
1. Overview
This document was prepared to provide an update to Attachment A – ‘Studley Park Gum Surveys Report’ which was provided to the Department of Environment, Land, Water and Planning (DELWP) in June 2019. Since this document was compiled, further work has been done to document the populations of Studley Park Gum outside the North East Link project boundary.

The additional surveys demonstrate that there are small numbers of Studley Park Gum in a number of locations near North East Link as well as a larger population on the eastern side of Simpson Barracks.

2. Survey method
To locate Studley Park Gum trees outside the North East Link project boundary but within Simpson Barracks, treed areas were surveyed using the same approach as discussed in Attachment A.

In addition to the Simpson Barracks survey, searches were conducted at nine additional locations outside the project boundary, out of 11 sites which were previously documented by Cameron et al. (1999).

Surveys were undertaken between 1 May and 17 June 2019 by experienced botanists.

3. Population
Surveys determined that there are approximately seven clusters of Studley Park Gum (either individual hybrid swarms or elements of a broader hybrid swarm) in the Simpson Barracks area. One of the largest clusters occurs within the project boundary and is discussed in Attachment A (with some refinements to numbers presented in Section 4 of this document).

The other largest cluster occurs immediately east of the project boundary near Greensborough Road, and this may well be operating with the population inside the project boundary as one large hybrid swarm cluster.

Three smaller clusters occur in the woodland in the eastern section of Simpson Barracks, and another cluster occurs to the east of the barracks in the Streeton Views Estate, south of Yallambie Road. One small cluster occurs north of Blamey Road. Within each cluster trees of multiple size classes occur, which most likely indicates the presence of different age classes, pointing to recruitment of Studley Park Gum in these ‘hotspots’. The highest proportion of trees in the intermediate size class (25 – 80 cm) were recorded within Simpson Barracks.
4. **Current distribution in the study area**

The survey recorded 184 trees in and around the project boundary. Most of the Studley Park Gum (127 individuals) occurred within Simpson Barracks, while 57 individuals occurred within the local area outside the barracks, between Watsonia and Kew. The majority of trees were in good condition and populations were comprised of trees varying in size from immature saplings to mature large trees with a girth of over one metre. Some of these trees were re-located from herbarium specimens outside the project boundary and have persisted at sites for many decades and up to 100 years in some cases. Young trees at Simpson Barracks were not included in the survey since they were too immature to confidently identify.

The range of size classes present throughout the study area suggest that Studley Park Gum is continuously regenerating, at least where suitable habitat and conditions exist for seedling recruitment, i.e. Simpson Barracks. Cameron et al. (1999) identified a loss of ‘natural ecological processes’ that are necessary to promote regeneration of hybrid populations and retain population viability, as a key threatening process for Studley Park Gum. Of potential concern for the taxon’s persistence is a reduction in the area and quality of suitable habitat into the future. Simpson Barracks was the only area inspected during the survey with intact native vegetation and natural ecological processes occurring (i.e. the ground layer was not slashed or mown), a significant proportion of which would be removed due to the project.

While trees are clearly able to persist in at least some urban settings, no recent regeneration was observed at any of these locations, apart from a single specimen in Viewbank. This suggests that the prognosis for long-term survivorship of the taxon in these locations is poor. The quantity of Studley Park Gum regeneration within Simpson Barracks (within and outside the project boundary) was unable to be determined owing to a lack of diagnostic characters. However, it is reasonable to expect that the extent of recruitment is likely to be related to the presence of both parent species in close proximity, and where active management of the ground layer via slashing or mowing is not occurring.

The results of the survey are presented in Table 1, Figure 1 and Figure 2. It should be noted that the higher number of ‘poor’ confidence specimens within Simpson Barracks is due to the fact that there were a higher number of younger trees present at the barracks which were more difficult to identify (compared to outside the barracks, where older more mature trees predominated).
### Table 1  Number of Studley Park Gum according to level of identification confidence

<table>
<thead>
<tr>
<th>Identification confidence class</th>
<th>Simpson Barracks – within the project boundary</th>
<th>Simpson Barracks – outside the project boundary</th>
<th>Outside Simpson Barracks and outside the project boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Moderate</td>
<td>Poor</td>
</tr>
<tr>
<td>Number of trees per class</td>
<td>19</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Proportion of the study area (n=184)</td>
<td>23.9%</td>
<td></td>
<td>45.1%</td>
</tr>
<tr>
<td>Total number of trees</td>
<td>44</td>
<td>83</td>
<td>57</td>
</tr>
</tbody>
</table>

In addition to the above, two Studley Park Gums were recorded during the surveys for the North East Link Environment Effects Statement (EES) within the project boundary near Watsonia Station as shown in figure 11-6 of EES Technical report Q – Ecology. These trees were not assessed using the method described in Attachment A which included recording the identification confidence level and tree condition. This survey was not informed by the specimens held at the National Herbarium of Victoria, Royal Botanic Garden or the publicly accessible Studley Park Gum that were visited before undertaking the targeted surveys. These individuals have conservatively been counted in the total impact presented in Section 6 of this memo.

### 5. Groundwater drawdown impacts

Since the groundwater assessment was completed for the EES additional data from the North East Link groundwater bore monitoring network have become available. Based on these new data, the groundwater drawdown modelling has subsequently been refined. These results supersede the results provided in Attachment A of this note.

Groundwater drawdown can be caused when tunnelling activities interact with the groundwater and cause a change in groundwater level. The change of level can cause degradation and decline of trees that potentially rely on this groundwater periodically during times of stress.

Based on the revised groundwater modelling, it is estimated that 11 large trees (i.e. DBH >80 cm) of Studley Park Gum would have a moderate or high risk of being negatively impacted by groundwater drawdown at the end of construction in 2024. However, it should be noted that environmental performance requirement (EPR) FF6 is planned to be modified to account for the potential impacts of groundwater drawdown during construction as follows:

*Where the survival of Groundwater Dependent Large Trees is predicted to be affected in construction or operation based on groundwater modelling outputs, measures should be included in the plan to maintain the health of large trees, such as supplementary watering where the impacts are deemed to have been caused by drawdown during construction, and offsets must be obtained in accordance with EPR FF2 for trees predicted to be impacted in operation.*
Given this, it is considered that three of these trees are likely to be impacted permanently as they would be affected by groundwater drawdown during operation (modelled year 2075).

6. Conclusion

Overall, considering the assessments described in this memorandum as well as the EES ecology assessment and Attachment A of this note (Studley Park Gum Surveys Report) there were 186 Studley Park Gum documented within and around the project boundary. Of these, the project would directly impact 46 Studley Park Gum (44 at Simpson Barracks and two at Watsonia Station) and indirectly impact an additional three Studley Park Gum due to groundwater drawdown during operation, resulting in a total impact to 49 Studley Park Gum trees.
This report is prepared to inform the Inquiry and Advisory Committee and the public about the North East Link. This report may be of assistance to you but the North East Link Project (a division of the Major Transport Infrastructure Authority) and its employees, contractors or consultants (including the issuer of this document) do not guarantee that the report is without any defect, error or omission of any kind or is appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this memorandum.