Arboricultural Report
Dendy Street Beach Pavilion
Brighton
4 April 2017
for
Denise Whitehead
Capital Projects Officer
Bayside City Council

Prepared by
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Brief

Arbor by Design has been requested to provide a Construction Impact Assessment and Tree Management Report for trees to be retained within the Dendy Street Beach Pavilion construction site.

The trees to be retained are identified on the Existing Conditions Site and Demolition Plan (AO 106) and have been assessed in the Assessment of Foreshore Vegetation around Dendy Street Pavilion, Brighton prepared by Homewood Consulting.

All recommendations and calculations are made with consideration of AS4970 Protection of Trees on Development Sites (AS4970).

Observations

A visual site inspection was undertaken by Sarah Priestley on 24th and 28th March and 2nd April 2017.

Trees

54 trees were identified within the proposed construction site as per Plan AO 106. Of these, 38 trees are proposed for retention. The tree population to be retained is comprised of eight different species (Table 1) with five indigenous species, two native and one exotic species.

Trees 1 to 36 are planted in garden beds adjacent the carpark. These garden beds vary in width from approximately 3-5 metres. Evidence of surface roots was observed in relation to a number of these trees.

Trees 37 to 54 are established in the passive open space to the north of the carpark. The trees are established a grassed slope.

The trees vary in health and structural form and their value in the landscape. The condition and retention value of the trees was assessed by Homewood Consulting and the conclusions of the resulting 'Assessment of Foreshore Vegetation around Dendy Street Pavilion, Brighton' have informed this report. The trees, their retention value and recommended Tree Protection Zones (TPZ) are contained in Appendix 1.

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Origin</th>
<th>No. of Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leptospermum laevigatum</td>
<td>Coast Tea-tree</td>
<td>Indigenous</td>
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<tr>
<td>Banksia integrifolia</td>
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<tr>
<td>Allocasuarina verticillata</td>
<td>Drooping She Oak</td>
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<td>Acacia retinodes</td>
<td>Wirilda</td>
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<tr>
<td>Melaleuca armillaris</td>
<td>Giant Honey Myrtle</td>
<td>Native</td>
<td>3</td>
</tr>
<tr>
<td>Pittosporum crassifolium</td>
<td>Karo</td>
<td>Exotic</td>
<td>1</td>
</tr>
<tr>
<td>Hakea drupacea</td>
<td>Sweet Hakea</td>
<td>Native</td>
<td>3</td>
</tr>
</tbody>
</table>
Site notes

- Existing Site
The existing site consists of a shared path, carpark, passive open space, public amenities block and the Brighton Life Saving Club building.

The shared path runs adjacent the Esplanade, above the carpark and passive open space.

The asphalt carpark is roughly triangular in shape and has two entrance/exits to the Esplanade. The carpark has a relatively steep cross fall from the road toward the foreshore embankment. A vehicle ramp exits the car park in the south-west corner and connects to the foreshore promenade. In the north-west corner of the carpark a pedestrian ramp runs across an embankment connecting the carpark to the Brighton Life Saving Club.

The passive open space is located to the north of the carpark and also has a significant cross fall from the Esplanade to the Foreshore Promenade.

The Brighton Life Saving Club and the public amenities block are located at the foot of the embankment, immediately adjacent to the foreshore promenade. The site is approximately 1320 square metres in area.

Tree planting has occurred in 3-5 metre wide garden beds around the carpark and within the passive open space area.

![Figure 1 Existing Site and Tree Protection Zones of trees to be retained (in Red)](image)

- Proposed Development
The proposal includes an upgrade of the existing carpark which will reduce the area it covers, and enable the bike path to be re-routed further away from the Esplanade.

A new pavilion is proposed to replace the two existing buildings, the building will be located level with the foreshore, however access will be provided by a second, paved, promenade area level with the carpark.

Additional pedestrian paths accessing the foreshore, and raingardens, will be constructed through the passive open space area to the North of the carpark.

38 trees located within the construction area are proposed for retention.
Figure 2 Proposed Development and Tree Protection Zones of trees to be retained (in Red)

**Impacts**

Of the 38 trees to be retained within the construction area:

- 25 trees will require works within the TPZ to remove existing infrastructure. These trees include Tree ID 1 to 5, 8, 9 to 24, 35, 36 and 48,
- eight trees will not be impacted by the proposed development. These trees include Tree ID 26, 29, 30, 31, 32, 46, 47 and 49,
- the development will encroach on the TPZ of five trees by less than 5%. These trees include Tree ID 5, 24 and 27, 44 and 45, and
- the development will encroach on the TPZ of 23 trees by more than 10%. These trees include Tree ID 1, 3, 8 to 23, 25, 35, 36, 42 and 48 (Appendix 1).

The construction of the shared and pedestrian paths will impact on the TPZ of 9 Trees, including Tree ID 1, 3, 5, 8, 36, 42, 44, 45 and 48 (Figure 3).

The construction of the upper promenade will impact on the TPZ of 18 trees, including Tree ID 9 to 25 and 27 (Figure 4).
The construction of the carpark will impact on the TPZ of eight trees, including Tree ID 8, 9, 10, 12, 15, 21, 35 and 36 (Figure 5).

The construction of the new building and connection to the upper promenade will require both cut and fill of the embankment to achieve under the current proposal. The TPZ of one tree, Tree ID 9, is likely to be impacted by the cut required and the TPZ of 12 trees, Tree ID 9 to 20, will be impacted by the fill (Figure 6).
Discussion

Tree Protection

The TPZ of a tree is a specified area, above and below ground, that is required to protect the trees crown and root plate and maintain the trees health and stability during works, and vigour and long-term viability after works.

With the exception of any construction shown on the final plans, all activity must be excluded from the TPZ to protect the trees. To ensure activity is restricted from the TPZ of trees

- Tree protection fencing is to be installed to encompass all of the TPZ. Where construction might damage the canopy of the tree, as in the case of trees with a prostate form (Tree ID .31, 32 and 42) the TPZ should encompass the TPZ and the canopy,
- The fencing is to be constructed with 1.8 metre steel mesh fence panels in accordance with AS4687 Galvanised Construction Site Temporary Fencing.
- the fencing to be clearly marked as Tree Protection Zone in accordance with AS4970 (Example sign attached).
- Once erected protective fencing must not be removed or altered during works without approval by a qualified arborist.
- If an existing hard surface is to be retained the TPZ will be protected from compaction or excavation in this area. Therefore the fencing may run along the edge of the hard surface as it abuts or enters the TPZ.

Where trees are clustered together, fencing may be installed that encircles the TPZ of all trees within the cluster (Figure 7).

Eight trees will not require works within their TPZ and can be fenced for the entire project, these trees include Tree ID 26, 29, 30, 31, 32, 46, 47 and 49.

Where works are required to complete construction, the fencing may be relocated to allow access to the works area. The relocation of the fence and implementation of works must be completed in accordance with the recommendations outlined in this report and adopted by Council as the preferred solution.

Removal of existing infrastructure

25 trees will require works within the TPZ to remove existing infrastructure. This work potentially includes the removal of the existing bike and pedestrian paths, carpark base and kerb, ticket machines, bollards, sign posts, power poles and bluestone retaining walls.

Evidence of surface roots were observed throughout the site, most likely due to the compacted nature of the soils. To minimise the possibility of damage to tree roots, the removal of paved surfaces, bluestone pavers and kerbs within the TPZ should be undertaken by hand.

Where infrastructure is set into a footing or foundation the infrastructure above ground is to be removed, however the footing or foundation should not be removed if it is located within the TPZ as this is likely to cause damage to the tree roots.

Tree protection fencing should be erected prior to works commencing and relocated to allow access to remove the infrastructure, whilst still protecting the remainder of the TPZ. Once the infrastructure removal is complete the fencing should be reinstated around the edge of the TPZ.
The trees that will require infrastructure removed from within their TPZ include Trees ID 1 to 5, 8, 9 to 24, 35, 36 and 48.

**Minor Encroachments**

The proposed works will encroach on the TPZ of Trees ID 5, 24 and 27, 44 and 45 by less than 10%.

AS4970 stipulates that a tree can tolerate an encroachment of less than 10% provided an undisturbed area of the same size or greater is available contiguous to the Tree Protection Zone and, other than fencing of the TPZ, no further protection measures are required.

Therefore, fencing can be erected around these trees, that excludes the area required for the construction works (Figure 7).

Fencing should be maintained for the duration of works on site.

**Major Encroachments**

AS4970 defines a major encroachment as excavation, compacted fill or machine trenching that encroaches upon more than 10% of the area of the TPZ or occurs inside the Structural Root Zone (SRZ). To ensure the tree remains viable these activities must be eliminated from the TPZ, or non-destructive root investigations undertaken by a qualified arborist to determine the extent of the damage that will occur.

The trees surrounding the carpark are established in a highly compact site and evidence of surface roots were observed in multiple locations. The majority of trees will be impacted by more than one element, and some, trees 9-21, will have constructed surfaces surrounding their entire root plate. Therefore the method of, and care during construction is integral to the ability to retain these trees.

The following recommendations must be incorporated into the project if the trees are to be retained and it is strongly recommended that a project arborist is retained to supervise all works within the TPZ’s of the trees.

- **Construction Elements**
  - **Shared and Pedestrian Paths**

  Shared and pedestrian paths will have a major encroachment on the TPZ of trees 1, 3, 8, 36, 42 and 48 (Figure 3) and the Structural Root Zones of trees 1, 3, 8 and 42.

  The proposed shared path impacts on Trees 1, 3, 8, 36 and 48. Consideration should be given to retaining the existing shared path and eliminating the need for any works in relation to the path. This option is particularly recommended for trees:

  - 1 and 48 where the encroachment is approximately 20% for each tree and the shared path is the only element encroaching on the TPZ.
  - 8 and 36 where the shared path is one of two elements encroaching on the TPZ and significantly increases the impact on the tree. If the path is realigned or constructed at above grade the additional elements can be managed to enable the retention of the trees.
If retention of the existing path is not a viable option, then the shared path must be constructed at
or above grade within the TPZ for all trees. All excavation, including strip and sheet excavation, must
be avoided within the TPZ of the trees.

Tree 42 cannot be retained if the pedestrian path adjacent
is constructed in the proposed location.

Tree 42 is a Melaleuca armillaris that has a prostate form,
the tree has been assessed as ‘if possible retain’ by
Homewood Consulting, further assessment concurs with
this conclusion. The canopy sits on the ground, extending
approximately 9 metres to the east of the trunk of the
tree, and 6 metres to the north (Figure 8).

To retain the tree the route of the path will need to be
relocated, if the relocated path sits within more than 10%
of the TPZ or intrudes on the SRZ then the path will need
to be constructed at or above grade with no excavation
within the TPZ. The SRZ for this tree is 2.1 metres in radius
and is shown in pink in Figure 8.

- **Carpark**

The proposed carpark will have a major encroachment on Trees 8, 10, 35, and 36. The carpark will
also contribute to the impact of construction in combination with, the shared path for Trees 8 and
36, and the promenade and proposed fill area for trees 9, 10, 12, 15 and 21.

To eliminate the impact of the carpark the following design modifications will be required:

- Construct kerbs, or eliminate them completely, within the TPZ of a tree in a manner that
does not require excavation.
  - The elimination of the kerb would allow runoff into the garden bed the trees are
    established in, and promote tree health.
- Install asphalt at or above grade, with no excavation, within the TPZ.
  - Consideration should be given to retaining the existing asphalt as a base for the new
carpark.

If this can be done it will mitigate the encroachment of the carpark on Trees 9, 10, 12, 15, and 21.

It will reduce the impact of the proposed carpark to 6.4% on Tree 8. This, coupled with the
mitigation of the encroachment of the bike path, would enable Tree 8 to be retained with minimal
impact.

The impact of the proposed carpark on Trees 35 and 36 cannot be mitigated by the above design
modifications.
Trees 35 and 36 are located in a garden bed that is raised approximately 100mm above the level of the existing carpark. The proposed carpark encroaches on the TPZ and SRZ of both trees and the likelihood of a significant portion of roots being within the encroachment is high and excavation of the roots will compromise the health and stability of these trees significantly.

There are two options to consider:

- Realignment of the carpark so the line of the kerb is outside the TPZ of these trees. This would mitigate the impact on tree 35, and reduce the impact on tree 36 to the encroachment of the proposed shared path, which can be mitigated.
- Removal of the trees. Tree 35 has been assessed as ‘not worth retaining’ and Tree 36 has been assessed as ‘if possible retain’ by Homewood Consulting and further assessment concurs with this conclusion. The amenity of these trees could be readily replaced with new planting.
  - **Promenade**

The construction of the upper promenade will impact on 16 trees, including Trees 9 to 23 and 25 (Figure 4).

Where the promenade is constructed at the existing ground level, within the TPZ of the trees the construction needs to minimise damage to tree roots. Surface roots were observed in several locations around trees 9 to 21 and minimising damage is essential to retaining these trees. Therefore it is recommended the promenade at ground level be:

- composed of a permeable material that will allow water and oxygen through to aid in promoting tree health,
- installed in a manner that does not require excavation within the TPZ for trees 22, 23 and 25, and
- be installed in a manner that does not require excavation or compaction within the TPZ for trees 9 to 21.
To the west of trees 9 to 21 the site drops away and an embankment and pedestrian path lead down to the foreshore (Figure 10). The northern section of the embankment has bluestone pavers acting as a retaining wall on either side of the path. It is highly likely there are tree roots within this embankment and therefore the TPZ of these trees must be protected.

The proposal currently indicates fill will be used to raise the ground level and enable the promenade to extend to the building. To raise the ground level over a tree’s roots reduces the amount of oxygen and water available to the tree’s roots. A lack of water and oxygen will result in senescence of the roots and lead to the death of the root system in this area. The fill area constitutes a major encroachment for trees 9 and 11 to 20. The loss of roots within the TPZ of these trees is likely to lead to senescence of the trees.

To minimise the impact of the proposed promenade over the existing embankment, the promenade must be designed in a manner that:

- minimises compaction and excavation within the TPZ of trees 9 to 20.
- Allows oxygen and water to penetrate to the existing ground level.

Potential solutions may include:

- Constructing a ‘deck’ on posts, this would be the preferred option. The deck must be designed/engineered to avoid placement of posts, and therefore excavation, within the TPZ of the trees.
  - If the construction of a deck is proposed, consideration should be given to retaining the existing bluestone pavers and path within the TPZ, along the embankment.
- A fill composed of a structural soil that enables the passage of water and oxygen through the soil, and is designed to prevent spaces between the structural soil components from being filled with matter.
  - **Cut of Embankment**

A cut is proposed to construct the Northern section of the Brighton Life Saving Club. It was not clear from the plans provided (drawing A 3-102) what the distance of the cut from the Northern edge of the building would be. It has therefore been assumed the cut will extend to the line of the embankment. If this is correct the cut will encroach on the TPZ of Tree 9 by approximately 1%.  

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*Figure 10 Showing embankment and path leading down to foreshore promenade*  

*Figure 11 Showing assumed extent of cut in bottom left of Tree 9 TPZ*
Provided all other recommendations are followed this encroachment should not impact on the tree significantly.

**Trees 9 – 21**

The retention of trees 9 – 21 is of importance to the project as they will provide visual screening of the new building from the homes on the Esplanade.

Trees 9–11 and 13-21 are *Banksia integrifolia* that exhibit good health and have been assessed as ‘Retain’, Tree 12 is an *Allocasuarina verticillata* that is in decline. Tree 12 may not survive the works no matter the care taken, due to its declining state.

A number of elements of the development will encroach on 30-75% of the TPZ’s of these trees. This level of encroachment is not supported by AS4970 and if the encroachment severs or compacts the trees roots it is unlikely they will survive the development.

To retain these trees the design and installation must conform with the recommendations in this report.

**Conclusion and Recommendations**

54 trees are proposed for retention in the Dendy Street Beach Pavilion site.

The proposed design will either not encroach on, or only have a minor encroachment, on the TPZ of 31 trees on site.

The proposed design encroaches significantly on 23 of the 54 trees proposed for retention.

- three trees cannot be retained without modification of the existing design,
- 1 tree, Tree 12, is in decline and may not survive the works no matter the care taken, however it definitely will not survive unless the recommendations in this report are implemented, and
- the remaining 20 trees cannot be retained unless the recommendations in this report are implemented.

If the recommendations in this report are not implemented, the impact on the trees will be significant and their retention in the long term is unlikely.

The following actions are recommended to mitigate the impact of the proposed works on the trees to be retained:

- a project arborist be retained to supervise any works within the TPZ of the trees.
- Tree Protection Fencing
  - Tree protection fencing is to be installed to encompass all of the TPZ. Where construction might damage the canopy of the tree, as in the case of trees with a prostate form (Tree ID .31, 32 and 42) the TPZ should encompass the TPZ and the canopy.
  - The fencing is to be constructed with 1.8 metre steel mesh fence panels in accordance with AS4687 Galvanised Construction Site Temporary Fencing.
  - the fencing to be clearly marked as Tree Protection Zone in accordance with AS4970 (Example sign attached).
Once erected protective fencing must not be removed or altered during works without approval by a qualified arborist.

- **Removal of existing infrastructure**
  - The removal of paved surfaces, bluestone pavers and kerbs within the TPZ is to be undertaken by hand to minimise the possibility of damage to tree roots.
  - Where infrastructure is set into a footing or foundation the infrastructure above ground is to be removed, and the footing or foundation retained to avoid damage to roots.

- **Trees 5, 24 and 27, 44 and 45**
  - The encroachment of the proposed construction on these trees is minimal and should not impact on the long term health or structure of the trees.
  - Tree Protection Fencing is to be erected around these trees, excluding the area required for the construction works (Figure 7).
  - Once erected protective fencing must not be removed or altered during works without approval by a qualified arborist.

- **Shared Paths**
  - The proposed shared path impacts on Trees 1, 3, 8, 36 and 48.
  - Consideration should be given to retaining the existing shared path
    - this option is particularly recommended for trees 1, 8, 36 and 48
  - If retention of the existing path is not a viable option:
    - the shared path must be constructed at or above grade within the TPZ for all trees.
    - All excavation, including strip and sheet excavation, must be avoided within the TPZ of the trees.

- **Pedestrian Paths**
  - Tree 42 cannot be retained under the current proposal
  - To retain Tree 42 the proposed pedestrian path must be relocated
    - to avoid the canopy which extends approximately 9 metres to the east of the trunk of the tree, and 6 metres to the north (Figure 8), and
    - to avoid the TPZ.
  - If the path encroaches on more than 10% of the TPZ or intrudes on the SRZ then the path will need to be constructed at or above grade with no excavation within the TPZ.
    - The SRZ for this tree is 2.1 metres in radius and is shown in pink in Figure 8.

- **Carpark**
  - The proposed carpark will encroach on Trees 8, 9, 10, 12, 15, 21, 35, and 36.
  - To eliminate the impact of the carpark on trees 8, 9, 10, 12, 15 and 21 design modifications will be required:
    - Construct kerbs in a manner that does not require excavation within the TPZ, or
    - eliminate kerbs within the TPZ in a manner that does not require excavation.
      - elimination of the kerb can allow runoff into the garden beds and promote tree health.
    - Install asphalt at or above grade, with no excavation, within the TPZ.
      - Consideration should be given to retaining the existing asphalt as a base for the new carpark.
To eliminate the impact of the carpark on trees 8, 9, 10, 12, 15 and 21 design modifications will be required:

- Realignment of the carpark so the line of the kerb is outside the TPZ of these trees, if this cannot be achieved removal of the trees will be required.
  - The amenity of these trees could be readily replaced with new planting.

Promenade

- The construction of the upper promenade will impact on 16 trees, including Trees 9 to 23 and 25 (Figure 4).
- Where the promenade is constructed at the existing ground level, within the TPZ of the trees the construction needs to:
  - be composed of a permeable material that will allow water and oxygen through to aid in promoting tree health,
  - be installed in a manner that does not require excavation within the TPZ for trees 22, 23 and 25, and
  - be installed in a manner that does not require excavation or compaction within the TPZ for trees 9 to 21.

- Where the promenade is constructed over the existing embankment the promenade must be designed in a manner that:
  - minimises compaction and excavation within the TPZ of trees 9 to 20.
  - Allows oxygen and water to penetrate to the existing ground level.
  - Potential solutions may include
    - a fill composed of a structural soil that enables the passage of water and oxygen through the soil, and is designed to prevent spaces between the structural soil components from being filled with matter.
    - Constructing a ‘deck’ on posts. The deck must be designed/engineered to avoid placement of posts, and therefore excavation, within the TPZ of the trees.

Cut of Embankment

- Assumptions were made, using information from drawing A 3-102, to the distance of the cut from the Northern edge of the building would be
- The assumed extent of cut will encroach on the TPZ of Tree 9 by approximately 1%.
- Provided all other recommendations are followed this encroachment should not impact on the tree significantly

If compaction and excavation within the TPZ of the trees can be avoided as per the recommendations above the proposed development should not impact significantly on the health or structure of the trees to be retained.
Management Plan

1. Before any works commence:
   a. The contractor is to submit a plan for approval that outlines how canopies will be protected from activities outside the TPZ.
   b. Tree Protection Fencing is to be erected around the Tree Protection Zone, and canopy of all trees to be retained on site.
      i. Fencing to be constructed with 1.8 metre steel mesh fence panels in accordance with AS4687 Galvanised Construction Site Temporary Fencing.
      ii. Fencing to be clearly marked as Tree Protection Zone in accordance with AS4970 (Example sign attached)
      iii. Fencing for Trees 5, 24 and 27, 44 and 45 may be modified by project arborist to exclude works area in keeping with AS4970 minor encroachment principles.
      iv. Once erected protective fencing must not be removed or altered without approval by the Project Arborist.
      v. Works are to be avoided within TPZ when soil is saturated to minimise compaction.
   c. **HOLD POINT:** The TPZ fencing needs to be approved by Councils arborists prior to works continuing

2. When works that encroach upon a TPZ are to commence the following is to be observed:
   a. A suitably qualified and experienced project arborist (approved by Council) to be on site to supervise works.
   b. The removal of existing infrastructure is to ensure:
      i. all hard surfaces within the TPZ are to be lifted by hand, and
      ii. footings and foundations of infrastructure within the TPZ to be removed to just below ground level and the concrete base retained to minimise damage to the root plate of the tree.
   c. Compaction of the soil within the TPZ is to be avoided.
      i. All vehicle activity must be excluded
      ii. Works must not proceed when soils are saturated

3. Excavation within the TPZ must be avoided or minimised to ensure tree health and stability.
   i. If it is required it must be
      1. consistent with methodology shown in construction plans.
      2. be carried out using non-destructive excavation methods in accordance with section 3.3.4 (a) of AS4970.
      3. Be supervised by the project arborist

4. Root pruning is to be avoided where possible, however if this is not possible:
a. Any root pruning is to consider the impact to the tree and its ongoing health, with no more than 10% root loss for a single tree.

b. Any severance of roots greater than 50mm in diameter within the TPZ must be approved by Councils Arborist.

c. All root pruning to be conducted by the project arborist in accordance with AS4970

5. At the completion of the works a report is to be provided by the supervising project arborist that confirms:

a. The Construction and Tree Management Plans were adhered to

b. Outlines any root pruning that exceeds the above conditions and justification for changes in accordance with AS4970.

Note: adherence to the requirements of the Tree Management Plan will be audited during construction inspections
TREES PROTECTION
ZONE

NO ACCESS

NO:

Machine Excavation
Storage
Preparation of chemicals, cement, etc
Parking of vehicles or equipment
Dumping of waste
Washing down or cleaning of equipment
Physical damage to tree

Any queries contact:
### Appendix 1: Impacts of construction elements

<table>
<thead>
<tr>
<th>ID</th>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Origin</th>
<th>TPZ (m)</th>
<th>Retention value</th>
<th>% Encroachment</th>
<th>% Paving</th>
<th>% carpark</th>
<th>% paths</th>
<th>% Fill</th>
<th>% Cut</th>
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<td>Coast Tea-tree</td>
<td>Indigenous</td>
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<td>8.03%</td>
<td>27.11%</td>
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<td>Retain</td>
<td>49.56%</td>
<td>30.86%</td>
<td>13.07%</td>
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<td>5.62%</td>
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<td>Not worth</td>
<td>64.25%</td>
<td>37.33%</td>
<td>9.84%</td>
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<td>Retain</td>
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<td>41.08%</td>
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