| DRAWING | TREE IDENTIFIER | VEGETATION TYPE | REMOVAL STATUS | DESCRIPTION | NATIVE / EXOTIC |
|---|---|---|---|---|---|
| | | | | *(Western Honey-myrtle), Melia azedarach (White Cedar), Portulacaria afra (Jade Plant), Pittosporum undulatum (Sweet Pittosporum) and weeds (Olea europaea, Asparagus asparagoides - several bridal creeper plants).* | |
| CS1-DRG-352327 | 794 | Regulated Tree | Remain | *Melaleuca armillaris*, multi-stem; weed *Asparagus asparagoides* (Bridal Creeper) climbing over lower branches. | Exotic / non-local natives |
| CS1-DRG-352327 | 796 | Significant Tree | Remain | *Melaleuca armillaris*, previously pruned for roadside clearance. Bee hive in main branch. Several *Asparagus asparagoides* (Bridal Creeper) plants adjacent tree. | Exotic / non-local natives |
| CS1-DRG-352327 | 797 | Regulated Tree | Remain | *Melaleuca nesophila* (Bracelet Honey-myrtle), multi stem, *Asparagus asparagoides* (Bridal Creeper) (declared) plants adjacent to tree, along fence line and spreading into rail corridor. | Exotic / non-local natives |
| CS1-DRG-352327 | 799 | Significant Tree | CSR being moved to save tree | *Eucalyptus camaldulensis var camaldulensis* (River Red Gum), multi stem | Local Native |
| CS1-DRG-352327 | 801 | Significant Tree | Minor PRUNE may be required | *Eucalyptus camaldulensis var camaldulensis* (River Red Gum), multi stem | Local Native |
| CS1-DRG-352327 | 830 | Amenity Tree | Removal | *Acacia iteaphylla* (Flinders Ranges Wattle) | SA Native |
| CS1-DRG-352327 | 795/798 | Amenity / declared weed patch | Remain | Screen planting between residential street and the rail corridor. Weeds as previous with additional environmental weed: *Arundo donax (Giant Reed). Amenity trees present include* Eucalyptus leucoxylon (SA Blue Gum), *Melaleuca armillaris* (Bracelet Honey-myrtle), *Melaleuca halmaturorum* (Swamp Paperbark), *Melaleuca nesophila* (Western Honey-myrtle), *Casuarina glauca* (Grey Buloak), *Olea europea* (declared weed). | Exotic / non-local / local natives |
| CS1-DRG-352327 | 800/802 | Amenity / declared weed patch | Remain | Screen planting between residential street and the rail corridor. *Eucalyptus camaldulensis var camaldulensis* (River Red Gum), *Eucalyptus conferruminata* (Bushy Yate), *Eucalyptus sp.*, *Melaleuca armillaris* (Bracelet Honey-myrtle), | Exotic / non-local / local natives |

| DRAWING | TREE IDENTIFIER | VEGETATION TYPE | REMOVAL STATUS | DESCRIPTION | NATIVE / EXOTIC |
|---|---|---|---|---|---|
| | | | | *Melaleuca decussata* (Totem-poles), *Melaleuca halmaturorum* (Swamp Paperbark), *Melaleuca nesophil*a (Western Honey-myrtle), resident garden plants (*Aeonium haworthii, Agave americana, Agave attenuata, Fucraea sp, Rosmarinus officinalis*). Weeds as previous with additional species: *Bromus sp., Fumaria capreolata and Oxalis pes-capr*ae. Additional environmental weed: *Galenia pubescens, Gallium sp. and Plantago lanceolata*. Declared plants here: *Anredera cordifolia* (Madiera Vine). | |
| CS1-DRG-352327 | 829/829 | Amenity Tree / Shrub | Remain | Planting along fence of disuses car park. Includes *Cupressus sempervirens var. stricta* (Itlalian Cyperus), *Cupressus macrocarpa* (Monterey Cyperus), *Ipomoea indica* (Purple Morning Glory). | Exotic |
| CS1-DRG-352327 | CS1-DRG-352327 | Amenity | Vegetation to be removed through swale | not part of EBS survey, east of rail, low vegetation between fence and industry opposite tree 797,796 | unknown |
| CS1-DRG-352328 | 833 | Regulated Tree | TO BE discussed ON SITE with arborist / alter drain width | *Corymbia citriodora* (Lemon Scented Gum); *Pandorea jasminoides* (Bower of Beauty) growing on fence adjacent tree. | Exotic / non-local natives |
| CS1-DRG-352328 | 834 | Amenity Tree | Removal | *Casuarina cunninghamiana* (River Oak) | Non-local native |
| CS1-DRG-352328 | 835 | Amenity Tree | Removal | *Syagrus romanzoffiana* (Cocos Palm) | Exotic |
| CS1-DRG-352328 | 831A | Amenity Tree | Removal | *Eucalyptus torquata* (Coral Gum) | Non-local native |
| CS1-DRG-352328 | 831B | Amenity Tree | Removal | *Ficus benjamina* (Weeping Fig) | Exotic |
| CS1-DRG-352328 | 832A | Amenity Tree | Removal | *Callistemon sp*. (Bottlebrushes) | Non-local native |
| CS1-DRG-352328 | 832B | Amenity Tree | Removal | Citrus sp. | Exotic |
| CS1-DRG-352328 | 836A | Amenity Tree | Removal | *Citrus sinensis* (Orange) | Exotic |
| CS1-DRG-352328 | 836B | Amenity Tree | TO BE ASSESSED ON SITE | *Citrus reticulata* (Mandarin) | Exotic |
| CS1-DRG-352329 | 809 | Amenity Tree | Removal | *Prunus dulcis* (Almond) | Exotic |
| CS1-DRG- | 810 | Amenity Tree | Removal | *Fraxinus angustifolia* (Desert Ash) | Exotic |

| DRAWING | TREE IDENTIFIER | VEGETATION TYPE | REMOVAL STATUS | DESCRIPTION | NATIVE / EXOTIC |
|---|---|---|---|---|---|
| 352329 | | | | | |
| CS1-DRG-352329 | 811 | Amenity Tree | Removal | Agonis flexuosa (Willow-myrtle) | Exotic |
| CS1-DRG-352329 | 815 | Significant Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Phoenix canariensis* (Canary Date Palm) | Exotic |
| CS1-DRG-352329 | 819 | Regulated Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Acacia salicina* (Broughton Willow) | Non-local native |
| CS1-DRG-352329 | 820 | Amenity Tree | TO BE ASSESSED ON SITE / footpath design | Eucalyptus sp. | Non-local native |
| CS1-DRG-352329 | 821 | Amenity Tree | Remain | Eucalyptus sp. | |
| CS1-DRG-352329 | 803A | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 803B | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 803C | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 803D | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 804A | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 804B | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 804C | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 805A | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 805B | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 805C | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 806A | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 806B | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 806C | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |

| DRAWING | TREE IDENTIFIER | VEGETATION TYPE | REMOVAL STATUS | DESCRIPTION | NATIVE / EXOTIC |
|---|---|---|---|---|---|
| CS1-DRG-352329 | 806D | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 807A | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 807B | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 808A | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 808B | Amenity Tree | Removal | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 812A | Amenity Tree | TO BE ASSESSED ON SITE | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 812B | Amenity Tree | TO BE ASSESSED ON SITE | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 813/814 | Amenity / declared weed patch | Remain | *Ulmus parvifolia* (Chinese Elm), *Osteospermum fruticosum* (Shrubby Daisy Bush), *Gazania rigens* (Gazania), *Olea europaea* (Declared Weed) | Exotic |
| CS1-DRG-352329 | 816A | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 816B | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 816C | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 816D | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 817A | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 817B | Amenity Tree | Removal; Row of trees to be planted here as | *Ulmus parvifolia* (Chinese Elm) | Exotic |

| DRAWING | TREE IDENTIFIER | VEGETATION TYPE | REMOVAL STATUS | DESCRIPTION | NATIVE / EXOTIC |
|---|---|---|---|---|---|
| | | | offset if meets geo-tech criteria | | |
| CS1-DRG-352329 | 817C | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 817D | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 818A | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 818B | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 818C | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 818D | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 818E | Amenity Tree | Removal; Row of trees to be planted here as offset if meets geo-tech criteria | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352329 | 825A | Amenity Tree | DUP (WORKS BY OTHERS) - Darlington already removed | *Corymbia citriodora* (Lemon Scented Gum) | Non-local native |
| CS1-DRG-352329 | 825B | Amentiy Tree | DUP (WORKS BY OTHERS) - Darlington already removed | *Corymbia citriodora* (Lemon Scented Gum) | Non-local native |
| CS1-DRG-352329 | 825C | Amenity Tree | DUP (WORKS BY OTHERS) - Darlington | *Corymbia citriodora* (Lemon Scented Gum) | Non-local native |

| DRAWING | TREE IDENTIFIER | VEGETATION TYPE | REMOVAL STATUS | DESCRIPTION | NATIVE / EXOTIC |
|---|---|---|---|---|---|
| | | | already removed | | |
| CS1-DRG-352329 | 840 | AMENITY / WEED PATCH | Remain | Regenerating *Acacia saligna* (Golden Wreath Wattle) | Non-local native |
| CS1-DRG-352329 | CS1-DRG-352329 | Amenity | VEGETATION TO BE REMOVED THROUGH FOOTPATH | not assessed as part of EBS survey, amenity trees between fence and footpath | unknown |
| CS1-DRG-352329 | CS1-DRG-352329 | Amenity | VEGETATION TO BE REMOVED THROUGH FOOTPATH | not assessed as part of EBS survey, amenity trees between fence and footpath | unknown |
| CS1-DRG-352329 | CS1-DRG-352329 | Amenity | VEGETATION TO BE REMOVED THROUGH SWITCHBACK RAMP | overlaps with amenity tree data at this location for 808a, 8,10, 811, 812a, 812b | unknown |
| CS1-DRG-352329 | CS1-DRG-352329 | Amenity | VEGETATION TO BE REMOVED THROUGH SWITCHBACK RAMP/FOOTPATH | not a separate patch - overlaps with amenity trees in this locaion, i.e. 815, 816a,b,cd,817a,b,c,d,818a,b,c,d,e,819 | unknown |
| CS1-DRG-352330 | 824 | Amenity Tree / Shrub | Remain | Garden bed between Tonsley Station car park and SA Ambulance station; *Agapanthus praecox, Iris germanica, Rosa sp*. | Exotic |
| CS1-DRG-352330 | 822/823 | Amenity / declared weed patch | Remain | Screen planting between Lynton Avenue and Sturt Road: *Eucalyptus sp., Melaleuca armillaris, Prunus dulcis, Ulmus parvifolia, Rhamnus alaternus, Olea europaea* (declared weed).<br>Environmental weed here include: *Arctotheca calendula, Avena sp., Fumaria capreolata, Gallium sp., Malva parviflora, Medicago polymorpha, Rapistrum rugosum and Sonchus oleraceus* | Exotic / non-local natives |
| CS1-DRG-352330 | 844A | Amenity Tree | Remain | *Pyrus sp.* (Ornamental Pear) | Exotic |
| CS1-DRG-352330 | 844B | Amenity Tree | Remain | *Pyrus sp*. (Ornamental Pear) | Exotic |
| CS1-DRG-352330 | 845/846 | Amenity Tree / Shrub | Remain | *Ulmus parvifolia* (Chinese Elm) | Exotic |
| CS1-DRG-352331 | 267 | Regulated Tree | Removal - (DUP) | *Eucalyptus camaldulensis var camaldulensis* (River Red Gum) | Local Native |
| CS1-DRG-352331 | 269 | Significant Tree | Removal - (DUP) | *Eucalyptus camaldulensis var camaldulensis* (River Red Gum) | Local Native |

| DRAWING | TREE IDENTIFIER | VEGETATION TYPE | REMOVAL STATUS | DESCRIPTION | NATIVE / EXOTIC |
|---|---|---|---|---|---|
| CS1-DRG-352331 | 254A | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 254B | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 254C | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 254D | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 254E | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 255A | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 255B | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 255C | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 255D | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 255E | Regulated Tree | Removal - (DUP) | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 270B | Amenity Tree | Remain | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 270C | Amenity Tree | Remain | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331 | 270D | Amenity Tree | Remain | *Eucalyptus cladocalyx* (Sugar Gum) | Non-local native |
| CS1-DRG-352331, CS1-DRG-352332 | 253 | Amenity Tree / Shrub | Removal (DUP) | *Eucalyptus camaldulensis var camaldulensis*; *Melia sp*. (Cedar), *Melaleuca sp*. (Teatree), Callistemon spp. (Bottlebrushes), *Leptospermum laevigatum* (Coastal Teatree), *Phoenix dactylifera* (Date Palm), Acacia sp. (wattle) | Exotic / non-local natives |
| CS1-DRG-352331, CS1-DRG-352332 | 268 | Amenity Tree / Shrub | Removal (DUP) | *Corymbia maculata* (Spotted Gum), *Eucalyptus camaldulensis var camaldulensis* (River Red Gum), planted over weedy grasses and herbs on embankment | Non-local / local native |
| CS1-DRG-352332 | 265 | Amenity Tree / Shrub | Removal - (DUP) | Eucalyptus spp. (Gum), planted over weedy grasses and herbs on embankment | Non-local Native |
| CS1-DRG-352332 | 849 | Amenity Tree / Shrub | Remain | overlaps with amenity trees here 850a,b,c, 851a; Dodonaea viscosa (Sticky Hopbush), Eucalyptus sp. | Local Native |

| DRAWING | TREE IDENTIFIER | VEGETATION TYPE | REMOVAL STATUS | DESCRIPTION | NATIVE / EXOTIC |
|---|---|---|---|---|---|
| CS1-DRG-352332 | 855 | Amenity Tree / Shrub | VEGETATION TO BE REMOVED THROUGH SWALE | *Dianella revoluta* (Flax Lily) | Local Native |
| CS1-DRG-352332 | 857 | Amenity Tree / Shrub | Remain | overlaps with amenity tree 858a; *Allocasuarina verticillata* (Drooping Sheoak), *Lomandra longifolia* (Spiny Mat-rush) | Local / non-local native |
| CS1-DRG-352332 | 861 | Amenity Tree / Shrub | Remain | overlaps with amenity tree 862a, *Allocasuarina verticillata, Lomandra longifolia* | Local / non-local native |
| CS1-DRG-352332 | - | | VEGETATION TO BE REMOVED EARTHWORKS INTERFACE(check this with DUP???) | (bottom of vp inset "a") | |
| CS1-DRG-352332 | 847/848 | Amenity Tree / Shrub | VEGETATION TO BE REMOVED THROUGH SWALE | Planting either side of drainage swale. *Calothamnus quadrifidus* (Common Net Bush), *Callistemon spp*. (Bottlebrush), *Leptospermum laevigatum* (Coast Tea-tree), *Melaleuca decussata* (Totem Poles), *Westringia f*ruticosa (Native Rosemary) | Non-local native |
| CS1-DRG-352332 | 850A | Amenity Tree | Remain | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 850B | Amenity Tree | Remain | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 850C | Amenity Tree | Remain | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 851A | Amenity Tree | Remove | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 851B | Amenity Tree | Remove | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 852A | Amenity Tree | Remove | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 852B | Amenity Tree | Remove | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 853A | Amenity Tree | Remain | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 853B | Amenity Tree | PRUNE | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 854A | Amenity Tree | Remain | *Eucalyptus microcarpa* (Grey Box) | Local Native |
| CS1-DRG-352332 | 854B | Amenity Tree | Remain | *Eucalyptus microcarpa* (Grey Box) | Local Native |

| DRAWING | TREE IDENTIFIER | VEGETATION TYPE | REMOVAL STATUS | DESCRIPTION | NATIVE / EXOTIC |
|---|---|---|---|---|---|
| CS1-DRG-352332 | 856A | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 856B | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 858A | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 858B | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 858C | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 859A | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 859B | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 859C | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 860A | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 860B | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 862A | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 862B | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 862C | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 863A | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 863B | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 863C | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 864B | Amenity Tree | Remain | *Allocasuarina verticillata* (Drooping Sheoak) | Local Native |
| CS1-DRG-352332 | 864A | Amenity Tree | Remain | *Eucalyptus camaldulensis var camaldulensis* (River Red Gum) | Local Native |
| CS1-DRG-352332 | - | Amenity Shrubs | Removal | Native amenity plantings and Cultural Art Sculpture | Planted local / non-local natives |

**Threatened species**

No threatened species were identified within the project corridor or considered reliant on the amenity vegetation that is present.

**Clearance**

Approval to clear or prune amenity vegetation with the project corridor is required by DPTI Senior Environmental Management Officer as per the DPTI Vegetation Removal Policy.

Approval to clear or prune the Regulated and Significant Trees as per the *Development Act* is required from the General Manager of the Infrastructure Delivery and Development Assessment Commission.

Approval to remove Declared Plants or environmental weeds that meet TSD size criteria is required by the Environmental Officer. No approval required for weed species that do not meet TSD size requirements.

**Specifications**

Project design and implementation adheres to the following principles:

- Every effort will be made to minimise the overall disturbance to vegetation outside the extent of works.
- Trees, not being removed as part of works, will be protected as much as possible during construction
  - refer AS4970/2009 Protection of Trees on Development Sites.
- Management of pest species, both flora and fauna (e.g. bees) will be undertaken, as required during construction.
- Any pruning work (including root pruning) will be carried out according to the Australian Standard for Pruning of Amenity Trees AS4373/2007.
- Revegetation will incorporate local provenance species, where suitable (refer RDP 12 Landscaping).
- New landscape elements that may “foul” train operations must be approved by the Manager Rail Infrastructure Management

# 7. Design Integration

## 7.1 Digital

Throughout the design development process the design team has utilised a BIM workflow to integrate the 3D design modelling across each of the design disciplines. A project Digital Engineering Execution plan has been developed and is being used through the detailed design phase (FLD-RDP01-STD-9999-ENG-0002) to detail the processes to incrementally develop a fully integrated 3D model. This model is updated weekly, used for our weekly coordination meetings and issued as a federated Navisworks model for all parties to undertaken an ongoing review.

## 7.2 Environmental

This section addresses the environmental requirements of the CSTR as it relates to this package.

Section 4 of Part D20 of the CSTR requires the design and construction methodology to maximise achievement of a range of environmental and sustainability objectives where possible subject to the broader requirements of the CSTR. Sustainability is addressed under Section 6.4. Environmental objectives specifically relevant to this package include heritage sites and vegetation and enhancement of the amenity in the project area with urban design and landscaping. These objectives are addressed as follows:

- Heritage and vegetation is addressed below under Environmentally Sensitive Areas.
- Landscaping is addressed in more detail in a separate Design Package – RDP12.
- Vegetation removal is summarised in 6.1.1 above and on the drawings related this package

### 7.2.1 Environmentally Sensitive Areas

As per the CSTR (D20, Section 6) the “design of the Works and Temporary Works must minimise the impact on any environmentally sensitive areas” and environmentally sensitive areas (ESAs) should be clearly shown on design drawings and translated onto Site Environmental Plans / Environmental Control Plans. Within the footprint of Flinders Station the Elevated Walkway background data suggests that ESAs include minimal vegetation and low risk heritage features.

Background data suggests that ESAs for the Flinders Link Project include amenity vegetation, and low risk Heritage areas (e.g. areas that have been previously disturbed) and low risk heritage sites (e.g. a modern sculpture near the FMC carpark where the pedestrian bridge will be built). Ecological and Heritage Gaps Analysis TANS (050 and 048, respectively) highlight areas of the Flinders Link Project area that are outside the wider Darlington Project area.

The design process will minimise impacts to native flora, significant trees, Aboriginal Heritage and non-Aboriginal Heritage sites. Spatial data of Environmentally Sensitive Areas will be incorporated into drawings, e.g. the Cultural Heritage Risk of each area is incorporated into the drawings relevant to this package. Detailed vegetation removal information is documented on vegetation removal drawings in this package (70% design).

### 7.2.2 Flora and Fauna

Vegetation surveys have been undertaken as part of the Darlington Project (EBS 2014, 2016). A gaps analysis indicated minor areas of the Flinders Link project area that were not included in the surveys and are summarised in TAN (050). A survey of the areas not done previously will be undertaken, if necessary (these areas are highlighted in Table 6-1 above. Minimal amenity vegetation is present within the footprint, there are several regulated trees that will be removed or pruned closer to Tonsley Station (refer Table 6-1). Vegetation removal is documented in– RDP25 Vegetation Removal Drawings at 70% design.

### 7.2.3 Heritage

Several non-Aboriginal Heritage items also occur within the vicinity of the project area (e.g. Fairford House, Coach House, Pumping Shed and Ford). The Heritage TAN (048) outlines the low risk for the project in terms on non-Aboriginal Heritage. Vibration impacts are also discussed in TAN 048 and are considered to be negligible, based on vibration studies for Darlington. TAN 048 also summarises Aboriginal Heritage for the Flinders Link project, following review of EBS 2017. The majority of the FlindersLink footprint is considered to be low-moderate risk and there are two small high risk areas (based on location and lack of previous disturbance).

Heritage risks will be managed during construction in accordance with recommendations in EBS Heritage 2017. Recommendations for high risk areas (as per TAN 048) include:

- Excavation monitoring in undisturbed soils until heavy compact clay / and / or rock (where archaeology will not be present) – though noted that the existing Gateway South JV procedure on the Darlington Upgrade Project includes exemptions which may extend to Flinders Link. These include no monitoring during piling / auguring, and no monitoring where disturbance is less than 200 mm BGL.
- Continue to implement the existing Gateway South JV site discovery / recovery procedure. Noting that DPTI guidelines for Aboriginal Objects, Sites and Remains: Discovery Guideline, DPTI 2013, (FLINKP1-DPTI-REP-0000-TEN0011) are also available. This guideline provides decision tools for areas within and outside section 23 authorization areas, communication protocols etc.
- These areas are marked on the Vegetation Removal drawings, refer CS1-DRG-352329, CS1-DRG-352330.

Recommendations for low – moderate risk areas include:

- Continue Cultural awareness training during induction as per existing Gateway South JV procedure
- Continue to implement the site discovery / recovery procedure as per Gateway South JV existing documentation.
- These areas are not marked on the Vegetation Removal Drawings, as they relate to all areas that are not high risk. They can be added to the drawings if required.

In addition, EBS Heritage (2017) identifies a modern sculpture that is present within the footprint of the elevated walkway that will be impacted. This sculpture is not protected under heritage legislation. It was created by Aboriginal artist Karl Telfer and cultural geographer Gavin Malone on commission from the Flinders Foundation. Refer Vegetation Removal Drawing CS1-DRG-352332.

EBS Heritage (2015) North-South Corridor - Darlington Upgrade Project Cultural Heritage Report - Kaurna. Report to Department of Planning, Transport and Infrastructure.

EBS Heritage (2017) Darlington Upgrade Project Flinders Link Rail Extension Cultural Heritage Risk Assessment. Report to Department of Planning, Transport and Infrastructure. EBS Heritage, Adelaide. Version 2

### 7.2.4 Contamination

Contamination report (TAN 049) summarises the understanding of soil and groundwater contamination in the area of the proposed Flinders Link project based on a desktop review of documentation provided and publically available information sources. No major risks were identified.

### 7.2.5 Water Quality

Not relevant to this package, refer to Landscaping package, key objectives of the CSTR are:

- Landscaping assessment and vegetation management shall constitute a HOLD POINT
- Swales should improve water quality and use natural rainfall
- Landscaping to be self-sustaining, with little ongoing maintenance

### 7.2.6 Noise and Vibration

Not relevant to this package.

## 7.3 Sustainability

A Sustainability Management Plan (SMP) has been prepared as part of the project. Outcomes of the Ecological Sustainable Development (ESD) acquittal were provided as part of RFI 040. DEWNR's Climate Change Unit approved the SMP and notes the inclusion of commitments on Ecologically Sustainable Development Strategies. It is also noted that during the detailed design phase a CEMP will be developed which will be used to minimise impacts to the environment.

Key principles that promote sustainable outcomes include:

- minimisation of operating costs
- durability
- minimisation of maintenance and asset replacement (to consequently minimise lifecycle cost and disruption to operations)
- minimisation of equipment replacement costs
- minimisation of cleaning costs
- minimisation of energy and water usage
- minimisation of waste

The design for this package incorporates the following initiatives:

Various measures to reduce clearance of vegetation and minimise impacts to significant and regulated trees, for example:

- Relocation of CST to retain Significant tree 799 (a River Red Gum)
- Options to discuss on-site minimisation of impacts with arborists / construction team to reduce impacts to Regulated tree 833 (a Lemon-scented Gum). Option to alter design of drain to minimse removal or loss of tree.
- Options to reduce loss of amenity trees 812A and 812B
- Options to reduce impact to amenity tree 820 through realignment of footpath
- Reinstating a row of trees (with local provenance species) that will be removed, depending on geo-technical criteria and criteria for vegetation species in the vicinity of electrified train lines (e.g. to reduce impacts associated with fouling of line).
- Opportunity to minimise impacts to amenity trees in the vicinity of FMC carpark (amenity tree 851b, 852a, 852b, 853b).
- Additional measures to reduce impacts of vegetation clearance relate to offsets and replacement of significant and regulated trees at the required ratios, are discussed further in the Landscaping Package RDP12.
- Opportunities to reuse Cultural Sculpture / plants that will be removed to construct the elevated walkway.

The SMP prepared by DPTI for the Public Works Committee submission identified a range of sustainability benefits of the Flinders Link project and additional opportunities to enhance sustainability. Many of these opportunities have been considered and incorporated into the design including improving connectivity for walking and cycling, minimisation of vegetation clearance (particularly significant and regulated trees) and

providing revegetation offsets with local provenance species where applicable to the function of the vegetation, via a landscape plan.

A Sustainability in Design Workshop was held on 30th November 2017 as per the CSTR (part D20, Section 5). Discussion at the workshop highlighted the importance of addressing connectivity with existing and future greenways and walking/cycling routes, integration with existing and planned future land use to enable sustainable development and opportunities to reduce material use and minimise waste. Vegetation removal design for this package aligns with these principles in terms of minimising clearance and retention of community amenity attributes. The outcomes of the workshop including initiatives and actions were documented in a report and have been provided to DPTI. Further discussions with DPTI / GWS are required regarding initiatives and further actions to that will inform future stages of the design.

## 7.4 Interdisciplinary Review

Prior to issue this package has undergone an interdisciplinary review. The evidence of this review is provided in Appendix B.

## 7.5 Safety in Design

Safety in Design is integral to all stages of design development and has been considered throughout this package. The Safety in Design register (GSFL-PRJ-PLN-9999-PRJ-0010) is contained within the project Safety in Design Report. No safety in design issues were identified relevant to this package.

## 7.6 Future Expansion

Not Applicable

## 7.7 Constructability

Tree removal has been coordinated with Gateway South to determine vegetation removal required for construction.

Vegetation identified on drawings as “subject to construction assessment on site” will be reviewed on site by Gateway South.

# 8. Stakeholder Consultation

- Flinders Link - MOM - 30% Design Presentation - Friday Morning (12/01/18)
- Flinders Link - MOM - 30% Design Presentation - Monday Morning (15/01/18)
- Flinders Link - MOM - 30% Design Presentation - Monday Afternoon (15/01/18)
- Flinders Link - MOM - DPTI Workshop - Tuesday 1 (13/02/18)
- Flinders Link - MOM - Weekly Design Meeting (19/02/18)
- Flinders Link - MOM - Weekly Design Meeting (27/02/18)
- Flinders Link - MOM - Weekly Design Meeting (05/03/18)
- Flinders Link - MOM - Weekly Design Meeting - 20/03/18
- Flinders Link - MOM - Weekly Design Meeting (09/04/18)
- Flinders Link - MOM - 70% Design Presentation - Rail Align, Civils (03/04/18)
- Flinders Link - MOM - 70% Design Presentation - CSR & CCTV + Lighting (03/04/18)

Minutes of these meetings and consultations are distributed and are kept within the project's ProjectWise server for record.

A 30% HAZOP workshop was held on 21 November 2017, attended by DPTI, Gateway South representatives and relevant stakeholders and authorities. A subsequent 70% HAZOP workshop was held on 9 March 2018.

# 9. Operations and Maintenance in design

There are no specific comments within the operations, maintenance and commissioning for this package 25. Further information of the ongoing maintenance of vegetation within the project site can be found within the landscape design packages.

## 9.1 Asset Management Register

Not applicable to this package.

# 10. Internal Verification

A list of the internal verification reviewers is presented in Table 10-1 with the signed verification records provided in Appendix C.

**Table 10-1: Internal Verification**

| Discipline | Reviewer |
|---|---|
| Vegetation Removal | Lara Daddow |
| | |

# 11. External Verification

## 11.1 Independent Design Certifier (IDC)

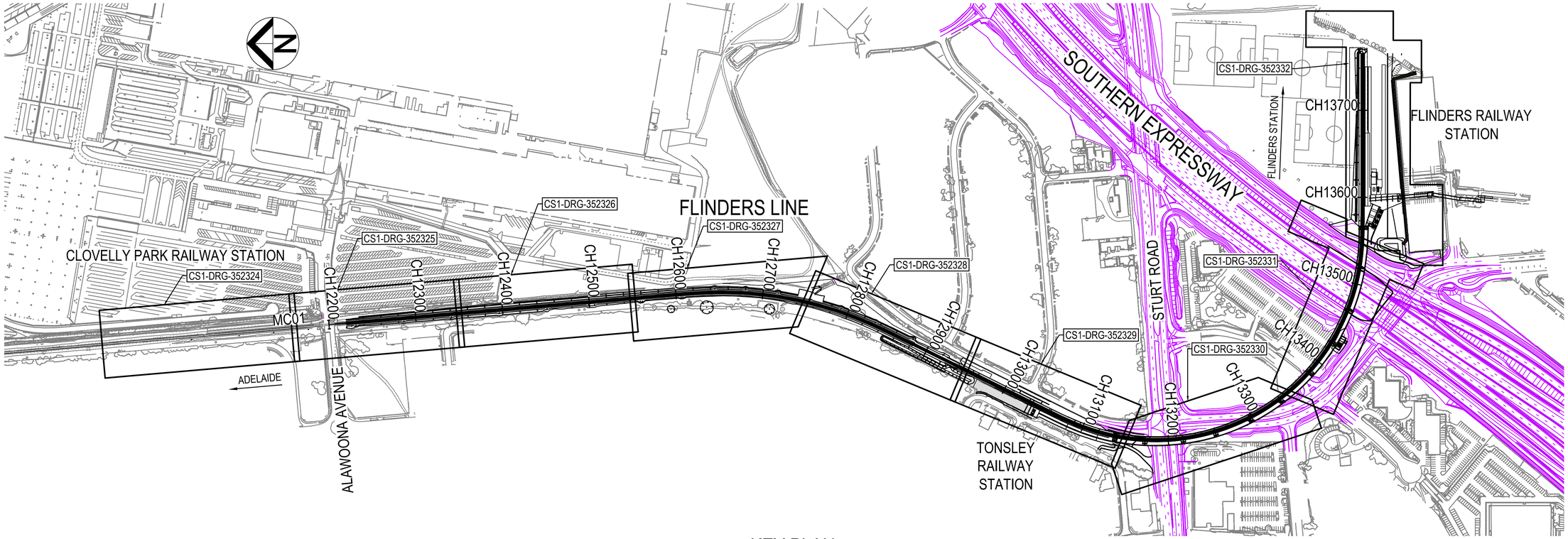
Not applicable to this issue

## 11.2 DPTI

Not applicable to this issue

# FLINDERS LINK PROJECT

## ENVIRONMENTAL




## DRAWING INDEX

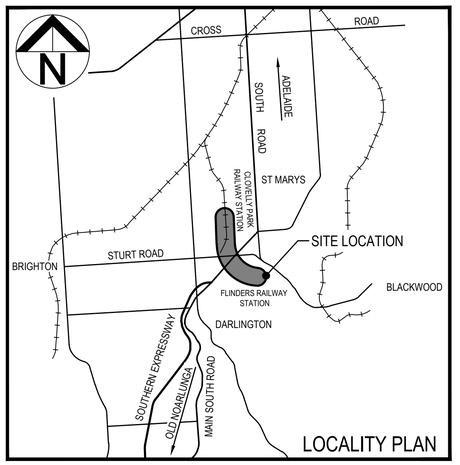
### TITLE AND INDEX

| SHEET | TITLE |
|---|---|
| CS1-DRG-352323 | VEGETATION REMOVAL |

### PLAN

| SHEET | TITLE |
|---|---|
| CS1-DRG-352324 | VEGETATION REMOVAL - SHEET 01 |
| CS1-DRG-352325 | VEGETATION REMOVAL - SHEET 02 |
| CS1-DRG-352326 | VEGETATION REMOVAL - SHEET 03 |
| CS1-DRG-352327 | VEGETATION REMOVAL - SHEET 04 |
| CS1-DRG-352328 | VEGETATION REMOVAL - SHEET 05 |
| CS1-DRG-352329 | VEGETATION REMOVAL - SHEET 06 |
| CS1-DRG-352330 | VEGETATION REMOVAL - SHEET 07 |
| CS1-DRG-352331 | VEGETATION REMOVAL - SHEET 08 |
| CS1-DRG-352332 | VEGETATION REMOVAL - SHEET 09 |

## KEY PLAN




| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
|---|---|---|---|---|---|---|
| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

NOT FOR CONSTRUCTION

RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

| DRAFTING CHECK: | ORIGINATE/DESIGN: | INDEPENDENT CHECK: | TECHNICAL APPROVAL: | PROJECT APPROVAL: | DATE: |
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| - | - | - | Z.BULL | D.RICHTER | 17.05.18 |

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CHECKED: FLD
APPROVED: -
TITLE: -
DATE: -

FLINDERS LINE
ENVIRONMENTAL
VEGETATION REMOVAL
TITLE AND INDEX

Government of South Australia
Department of Planning, Transport and Infrastructure

CS1-DRG-352323

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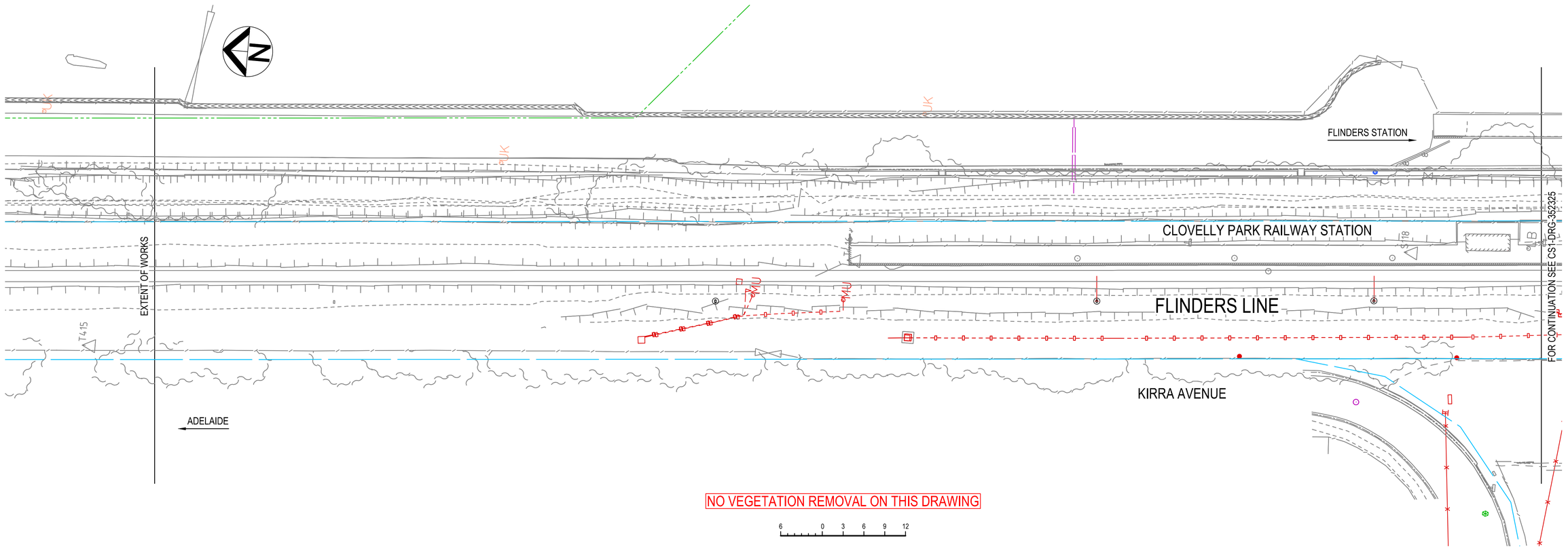


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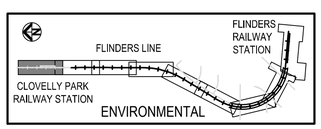


## NOTES (ENVIRONMENTAL):

1. TREE PROTECTION RE UIREMENTS TO BE ASSESSED AT TIME OF CONSTRUCTION BY SUPERINTENDENTS REPRESENTATIVE.
2. REFER TO VEGETATION SURVEY N . VS 2016/072 VS 2014/022 FOR INFORMATION ON EXISTING TREES.
3. REFER DPTI MASTER SPECIFICATION PART CH50 FOR THE ENVIRONMENTAL RE UIREMENTS.

## LEGEND (OTHER)

| SYMBOL | DESCRIPTION |
|---|---|
| | EXISTING SURVEY |
| | EXISTING SURVEY CONSTRUCTION WORKS CURRENTLY IN PROGRESS (BY OTHERS) |
| D D | VEGETATION AND TREE REMOVAL CURRENTLY IN PROGRESS (BY OTHERS) |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
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| | TREES TO BE REMOVED |
| 1 | SIGNIFICANT TREE |
| 1 | REGULATED TREE |
| 1 | AMENITY TREE |
| | HIGH CULTURAL RISK AREA |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| ? | TREE REMOVAL TO BE ASSESSED AT TIME OF CONSTRUCTION BY OFFICERS FROM DPTI LANDSCAPE UNIT / ARBORIST |
| P | PRUNE |
| | VEGETATION TO BE REMOVED |
| 1 | AMENITY VEGETATION IDENTIFIER ( . AMENITY NUMBER 1 ) |
| | AMENITY TREE / SHRUBS |
| | AMENITY / DECLARED WEED PATCH |
| | AMENITY / WEED PATCH |

| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
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| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

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RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

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DATE: -

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VEGETATION REMOVAL - SHEET 01
PLAN

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CS1-DRG-352324

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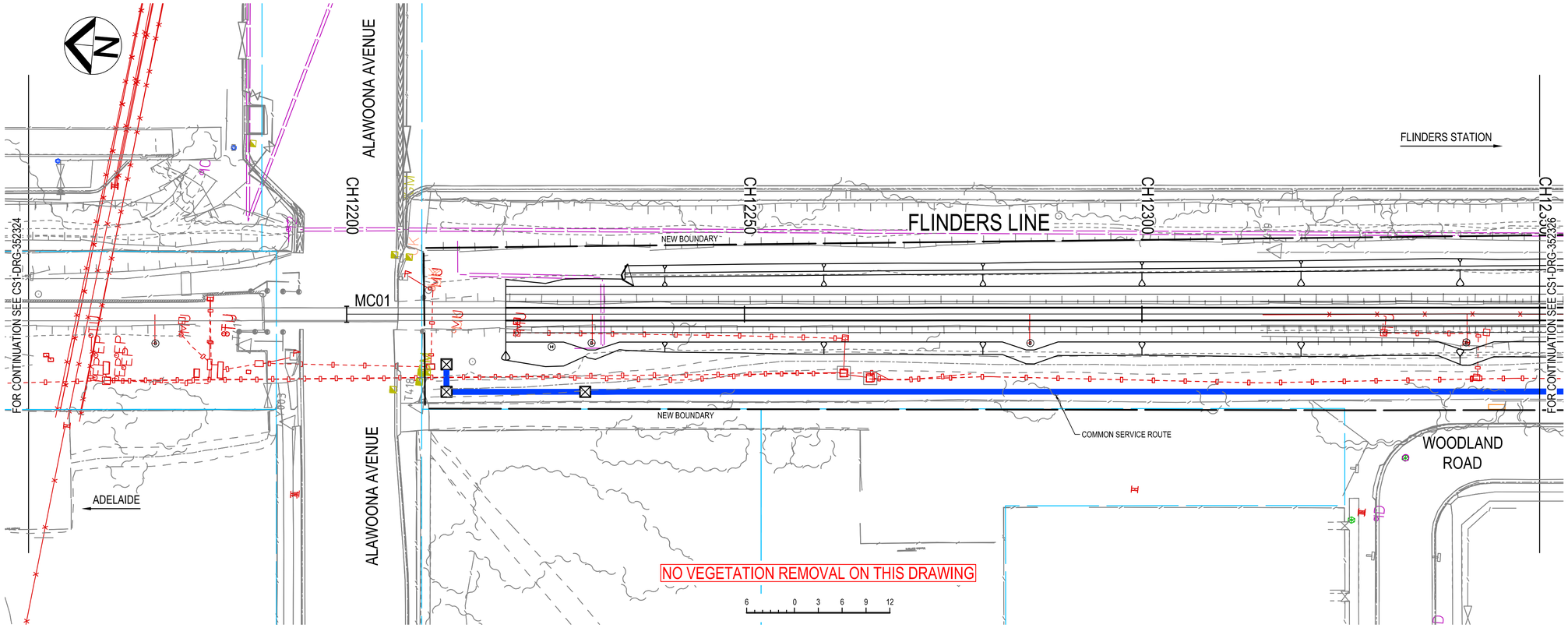


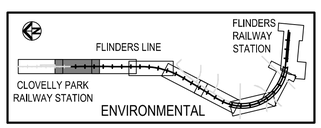


## NOTES (ENVIRONMENTAL):

1. TREE PROTECTION RE UIREMENTS TO BE ASSESSED AT TIME OF CONSTRUCTION BY SUPERINTENDENTS REPRESENTATIVE.
2. REFER TO VEGETATION SURVEY N . VS 2016/072 VS 2014/022 FOR INFORMATION ON EXISTING TREES.
3. REFER DPTI MASTER SPECIFICATION PART CH50 FOR THE ENVIRONMENTAL RE UIREMENTS.

## LEGEND (OTHER)

| SYMBOL | DESCRIPTION |
|---|---|
| | EXISTING SURVEY |
| | EXISTING SURVEY CONSTRUCTION WORKS CURRENTLY IN PROGRESS (BY OTHERS) |
| D D | VEGETATION AND TREE REMOVAL CURRENTLY IN PROGRESS (BY OTHERS) |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
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| | TREES TO BE REMOVED |
| 1 | SIGNIFICANT TREE |
| 1 | REGULATED TREE |
| 1 | AMENITY TREE |
| | HIGH CULTURAL RISK AREA |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| ? | TREE REMOVAL TO BE ASSESSED AT TIME OF CONSTRUCTION BY OFFICERS FROM DPTI LANDSCAPE UNIT / ARBORIST |
| P | PRUNE |
| | VEGETATION TO BE REMOVED |
| 1 | AMENITY VEGETATION IDENTIFIER ( . AMENITY NUMBER 1 ) |
| | AMENITY TREE / SHRUBS |
| | AMENITY / DECLARED WEED PATCH |
| | AMENITY / WEED PATCH |

| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
|---|---|---|---|---|---|---|
| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

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RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

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CS1-DRG-352325

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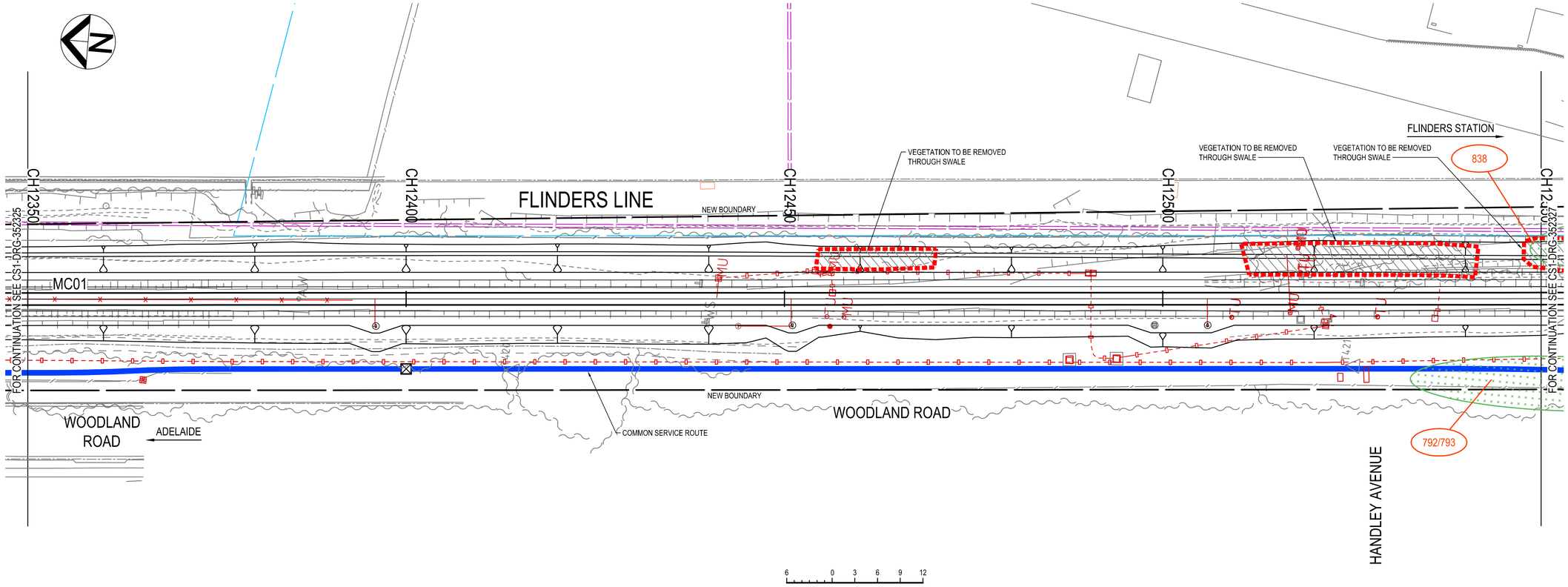


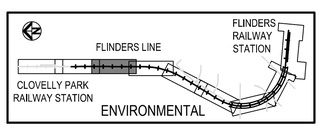


## NOTES (ENVIRONMENTAL):

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2. REFER TO VEGETATION SURVEY N . VS 2016/072 VS 2014/022 FOR INFORMATION ON EXISTING TREES.
3. REFER DPTI MASTER SPECIFICATION PART CH50 FOR THE ENVIRONMENTAL RE UIREMENTS.

## LEGEND (OTHER)

| SYMBOL | DESCRIPTION |
|---|---|
| | EXISTING SURVEY |
| | EXISTING SURVEY CONSTRUCTION WORKS CURRENTLY IN PROGRESS (BY OTHERS) |
| D D | VEGETATION AND TREE REMOVAL CURRENTLY IN PROGRESS (BY OTHERS) |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| 1 | VEGETATION SURVEY VS 2016/072 VS2014/022 TREE IDENTIFIER ( . TREE NUMBER 1 ) |
| | TREES TO BE REMOVED |
| 1 | SIGNIFICANT TREE |
| 1 | REGULATED TREE |
| 1 | AMENITY TREE |
| | HIGH CULTURAL RISK AREA |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| ? | TREE REMOVAL TO BE ASSESSED AT TIME OF CONSTRUCTION BY OFFICERS FROM DPTI LANDSCAPE UNIT / ARBORIST |
| P | PRUNE |
| | VEGETATION TO BE REMOVED |
| 1 | AMENITY VEGETATION IDENTIFIER ( . AMENITY NUMBER 1 ) |
| | AMENITY TREE / SHRUBS |
| | AMENITY / DECLARED WEED PATCH |
| | AMENITY / WEED PATCH |

| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
|---|---|---|---|---|---|---|
| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

NOT FOR CONSTRUCTION

RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

| DRAFTING CHECK: | ORIGINATE/DESIGN: | INDEPENDENT CHECK: | TECHNICAL APPROVAL: | PROJECT APPROVAL: | DATE: |
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| - | - | - | Z.BULL | D.RICHTER | 17.05.18 |

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TITLE: -
DATE: -

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Department of Planning, Transport and Infrastructure

CS1-DRG-352326

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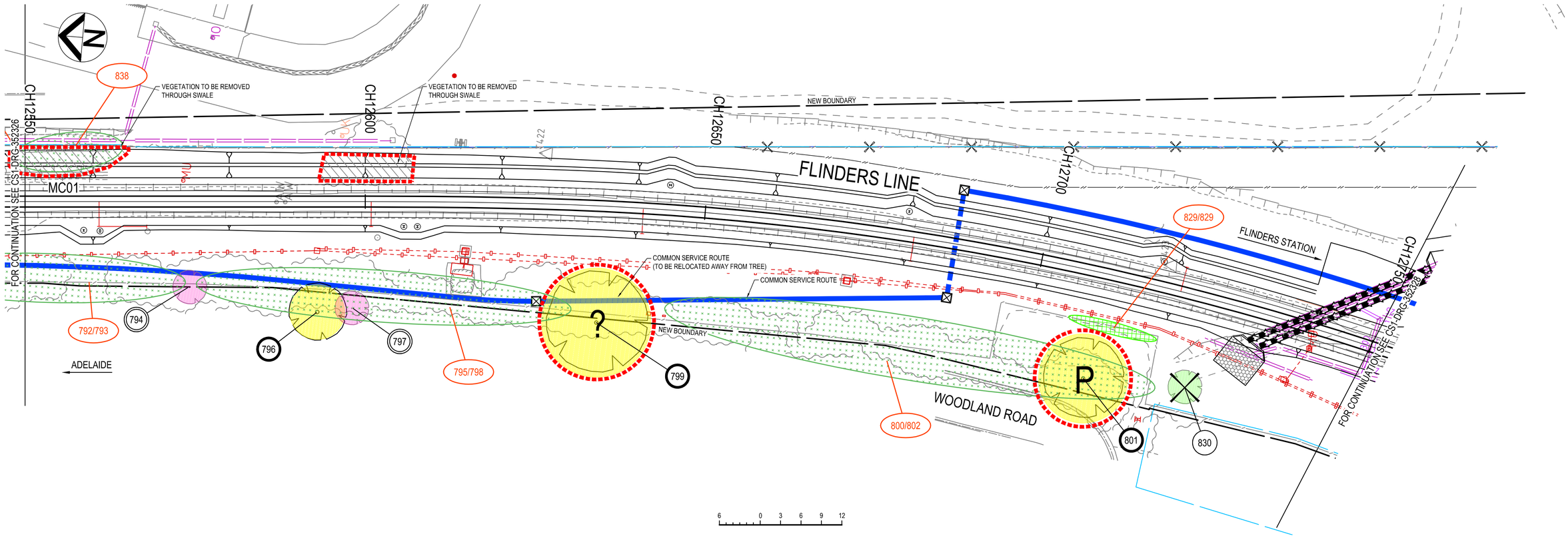
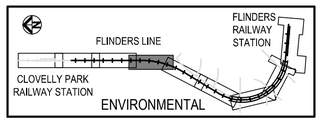



| VEGETATION SURVEY | TREE MARKER ID | PHOTO REFERENCE | STATUS | SPECIES | EASTING | NORTHING | DA SUBMISISON REMOVAL APPROVED | REMOVAL RE UIRED | TPZ ( ) BUTT DIAM 1 X 12 |
|---|---|---|---|---|---|---|---|---|---|
| VS 2016/072 | 794 | 794 | R d | *Melaleuca armillaris* | 278023 | 6122968 | R | N | 5.2 |
| VS 2016/072 | 797 | 797 | R d | *Melaleuca nesophila* | 278022 | 6122944 | R | N | 5.8 |
| VS 2016/072 | 796 | 796 | Significant | *Melaleuca armillaris* | 278021 | 6122949 | Pr | N | 7.6 |
| VS 2016/072 | 799 | 799 | Significant | *Eucalyptus camaldulensis var camaldulensis* | 278023 | 6122908 | Pr | M r Pr / ? | 15.0 |
| VS 2016/072 | 801 | 801 | Significant | *Eucalyptus camaldulensis var camaldulensis* | 278021 | 6122836 | Pr | M r Pr | 11.6 |

NOTE:
S1 FOR PHOTO REFERENCE , SEE DPTI VS 2016/072 & DPTI VS 2014/022
S2 "PRUNE" ALSO RELATED TO IMPACT TO ROOTS WITHIN TPZ.
S3 "TPZ" DENOTES TREE PROTECTION ZONE




## NOTES (ENVIRONMENTAL):

1. TREE PROTECTION RE UIREMENTS TO BE ASSESSED AT TIME OF CONSTRUCTION BY SUPERINTENDENTS REPRESENTATIVE.
2. REFER TO VEGETATION SURVEY N . VS 2016/072 VS 2014/022 FOR INFORMATION ON EXISTING TREES.
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## LEGEND (OTHER)

| SYMBOL | DESCRIPTION |
|---|---|
| | EXISTING SURVEY |
| | EXISTING SURVEY CONSTRUCTION WORKS CURRENTLY IN PROGRESS (BY OTHERS) |
| D D | VEGETATION AND TREE REMOVAL CURRENTLY IN PROGRESS (BY OTHERS) |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| 1 | VEGETATION SURVEY /VS 2016/072 /VS2014/022 TREE IDENTIFIER ( . TREE NUMBER 1 ) |
| | TREES TO BE REMOVED |
| 1 | SIGNIFICANT TREE |
| 1 | REGULATED TREE |
| 1 | AMENITY TREE |
| | HIGH CULTURAL RISK AREA |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| ? | TREE REMOVAL TO BE ASSESSED AT TIME OF CONSTRUCTION BY OFFICERS FROM DPTI LANDSCAPE UNIT / ARBORIST |
| P | PRUNE |
| | VEGETATION TO BE REMOVED |
| 1 | AMENITY VEGETATION IDENTIFIER ( . AMENITY NUMBER 1 ) |
| | AMENITY TREE / SHRUBS |
| | AMENITY / DECLARED WEED PATCH |
| | AMENITY / WEED PATCH |

| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
|---|---|---|---|---|---|---|
| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

NOT FOR CONSTRUCTION

RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

| DRAFTING CHECK: | ORIGINATE/DESIGN: | INDEPENDENT CHECK: | TECHNICAL APPROVAL: | PROJECT APPROVAL: | DATE: |
|---|---|---|---|---|---|
| - | - | - | Z.BULL | D.RICHTER | 17.05.18 |

100 MILLIMETRES ON ORIGINAL DRAWING — ALL DIMENSIONS ARE IN METRES UNO

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DRAFTED: FLD
CHECKED: FLD
APPROVED: -
TITLE: -
DATE: -

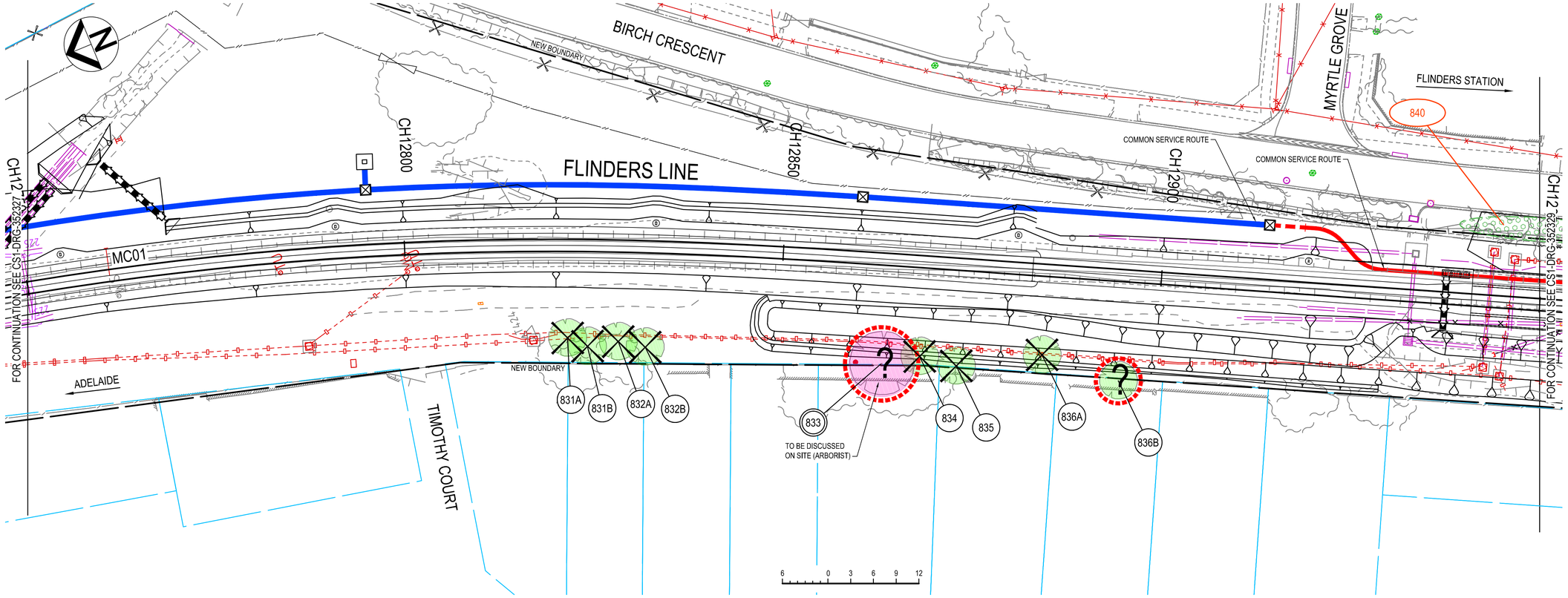
FLINDERS LINE
ENVIRONMENTAL
VEGETATION REMOVAL - SHEET 04
PLAN

Government of South Australia
Department of Planning, Transport and Infrastructure

CS1-DRG-352327

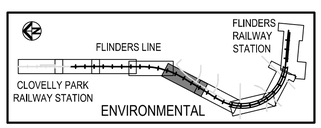
SCALE(S): 1:300 | SIZE: A1
REVISION: A | SHEET: 5 OF 10

CAD FILE NAME CS1-DRG-352327.DWG PLOTTED: Thursday, 17 May 2018 4:26:08 PM




| VEGETATION SURVEY | TREE MARKER ID | PHOTO REFERENCE | STATUS | SPECIES | EASTING | NORTHING | DA SUBMISISON REMOVAL APPROVED | REMOVAL REQUIRED | TPZ (m) BUTT DIAM@1m X 12 |
|---|---|---|---|---|---|---|---|---|---|
| VS 2016/072 | 833 | 833 | Regulated | *Corymbia citriodora* | 277977 | 6122694 | Removal | Minor Prune / ? | 7.8 |

NOTE:
S1 FOR PHOTO REFERENCE , SEE DPTI VS 2016/072 & DPTI VS 2014/022
S2 "PRUNE" ALSO RELATED TO IMPACT TO ROOTS WITHIN TPZ.
S3 "TPZ" DENOTES TREE PROTECTION ZONE




## NOTES (ENVIRONMENTAL):

1. TREE PROTECTION RE UIREMENTS TO BE ASSESSED AT TIME OF CONSTRUCTION BY SUPERINTENDENTS REPRESENTATIVE.
2. REFER TO VEGETATION SURVEY N . VS 2016/072 VS 2014/022 FOR INFORMATION ON EXISTING TREES.
3. REFER DPTI MASTER SPECIFICATION PART CH50 FOR THE ENVIRONMENTAL RE UIREMENTS.

## LEGEND (OTHER)

| SYMBOL | DESCRIPTION |
|---|---|
| | EXISTING SURVEY |
| | EXISTING SURVEY CONSTRUCTION WORKS CURRENTLY IN PROGRESS (BY OTHERS) |
| D D | VEGETATION AND TREE REMOVAL CURRENTLY IN PROGRESS (BY OTHERS) |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| 1 | VEGETATION SURVEY VS 2016/072 VS2014/022 TREE IDENTIFIER ( . TREE NUMBER 1 ) |
| | TREES TO BE REMOVED |
| 1 | SIGNIFICANT TREE |
| 1 | REGULATED TREE |
| 1 | AMENITY TREE |
| | HIGH CULTURAL RISK AREA |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| ? | TREE REMOVAL TO BE ASSESSED AT TIME OF CONSTRUCTION BY OFFICERS FROM DPTI LANDSCAPE UNIT / ARBORIST |
| P | PRUNE |
| | VEGETATION TO BE REMOVED |
| 1 | AMENITY VEGETATION IDENTIFIER ( . AMENITY NUMBER 1 ) |
| | AMENITY TREE / SHRUBS |
| | AMENITY / DECLARED WEED PATCH |
| | AMENITY / WEED PATCH |

| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
|---|---|---|---|---|---|---|
| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

NOT FOR CONSTRUCTION

RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

| DRAFTING CHECK: | ORIGINATE/DESIGN: | INDEPENDENT CHECK: | TECHNICAL APPROVAL: | PROJECT APPROVAL: | DATE: |
|---|---|---|---|---|---|
| - | - | - | Z.BULL | D.RICHTER | 17.05.18 |

100 MILLIMETRES ON ORIGINAL DRAWING — ALL DIMENSIONS ARE IN METRES UNO

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CHECKED: FLD
APPROVED: -
TITLE: -
DATE: -

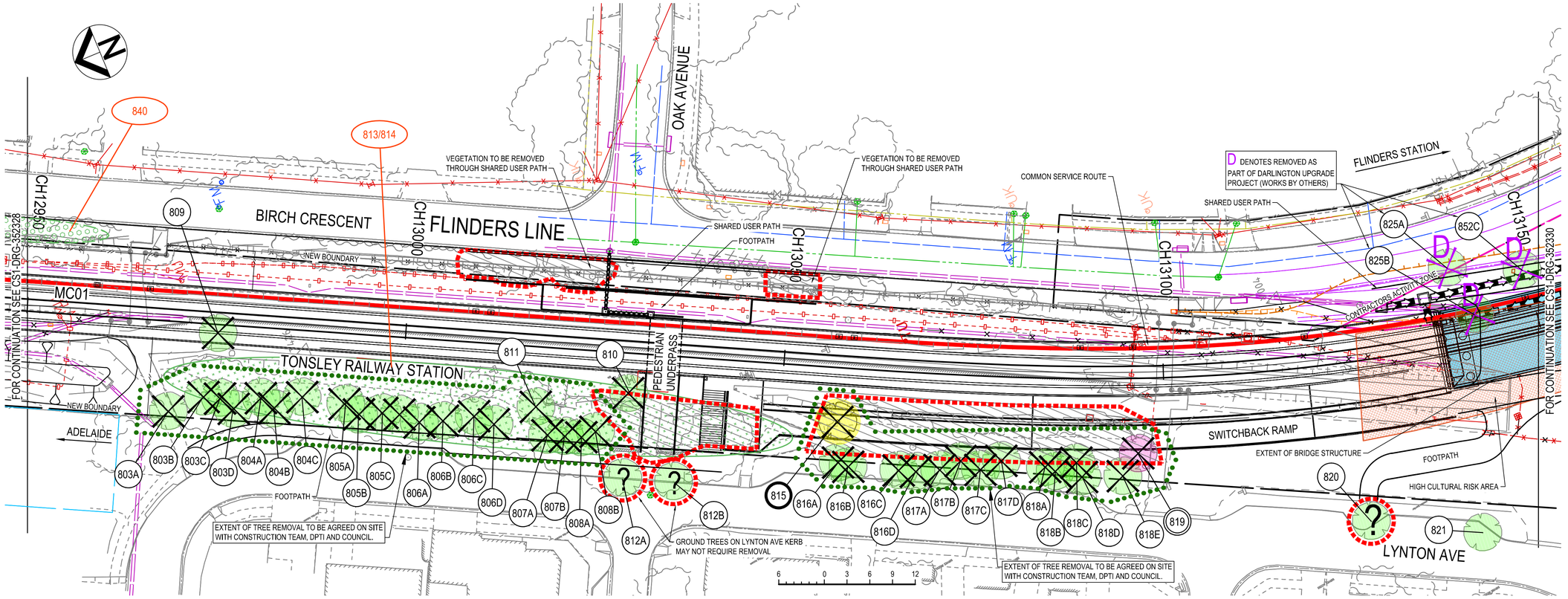
FLINDERS LINE
ENVIRONMENTAL
VEGETATION REMOVAL - SHEET 05
PLAN

Government of South Australia
Department of Planning, Transport and Infrastructure

CS1-DRG-352328

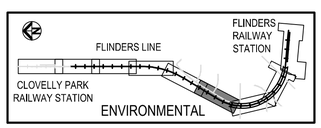
SCALE(S): 1:300 SIZE: A1
REVISION: A SHEET: 6 OF 10

CAD FILE NAME: CS1-DRG-352328.DWG PLOTTED: Thursday, 17 May 2018 12:00:19 PM




| VEGETATION SURVEY | TREE MARKER ID | PHOTO REFERENCE | STATUS | SPECIES | EASTING | NORTHING | DA SUBMISISON REMOVAL APPROVED | REMOVAL REQUIRED | TPZ (m) BUTT DIAM@1m X 12 |
|---|---|---|---|---|---|---|---|---|---|
| VS 2016/072 | 819 | 819 | Regulated | *Acacia salicina* | 277877 | 6122483 | Removal | Removal | 5.8 |
| VS 2016/072 | 815 | 815 | **Significant** | *Phoenix canariensis* | 277896 | 6122518 | Prune | Removal | 4.5 |

NOTE:
S1 FOR PHOTO REFERENCE , SEE DPTI VS 2016/072 & DPTI VS 2014/022
S2 "PRUNE" ALSO RELATED TO IMPACT TO ROOTS WITHIN TPZ.
S3 "TPZ" DENOTES TREE PROTECTION ZONE




## NOTES (ENVIRONMENTAL):

1. TREE PROTECTION RE UIREMENTS TO BE ASSESSED AT TIME OF CONSTRUCTION BY SUPERINTENDENTS REPRESENTATIVE.
2. REFER TO VEGETATION SURVEY N . VS 2016/072 VS 2014/022 FOR INFORMATION ON EXISTING TREES.
3. REFER DPTI MASTER SPECIFICATION PART CH50 FOR THE ENVIRONMENTAL RE UIREMENTS.

## LEGEND (OTHER)

| SYMBOL | DESCRIPTION |
|---|---|
| | EXISTING SURVEY |
| | EXISTING SURVEY CONSTRUCTION WORKS CURRENTLY IN PROGRESS (BY OTHERS) |
| D D | VEGETATION AND TREE REMOVAL CURRENTLY IN PROGRESS (BY OTHERS) |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| 1 | VEGETATION SURVEY VS 2016/072 VS2014/022 TREE IDENTIFIER ( . TREE NUMBER 1 ) |
| | TREES TO BE REMOVED |
| 1 | SIGNIFICANT TREE |
| 1 | REGULATED TREE |
| 1 | AMENITY TREE |
| | HIGH CULTURAL RISK AREA |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| ? | TREE REMOVAL TO BE ASSESSED AT TIME OF CONSTRUCTION BY OFFICERS FROM DPTI LANDSCAPE UNIT / ARBORIST |
| P | PRUNE |
| | VEGETATION TO BE REMOVED |
| 1 | AMENITY VEGETATION IDENTIFIER ( . AMENITY NUMBER 1 ) |
| | AMENITY TREE / SHRUBS |
| | AMENITY / DECLARED WEED PATCH |
| | AMENITY / WEED PATCH |

| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
|---|---|---|---|---|---|---|
| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

NOT FOR CONSTRUCTION

RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

| DRAFTING CHECK: | ORIGINATE/DESIGN: | INDEPENDENT CHECK: | TECHNICAL APPROVAL: | PROJECT APPROVAL: | DATE: |
|---|---|---|---|---|---|
| - | - | - | Z.BULL | D.RICHTER | 17.05.18 |

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APPROVED: -
TITLE: -
DATE: -

FLINDERS LINE
ENVIRONMENTAL
VEGETATION REMOVAL - SHEET 06
PLAN

Government of South Australia
Department of Planning, Transport and Infrastructure

CS1-DRG-352329

SCALE(S): 1:300 SIZE: A1
REVISION: A SHEET: 7 OF 10

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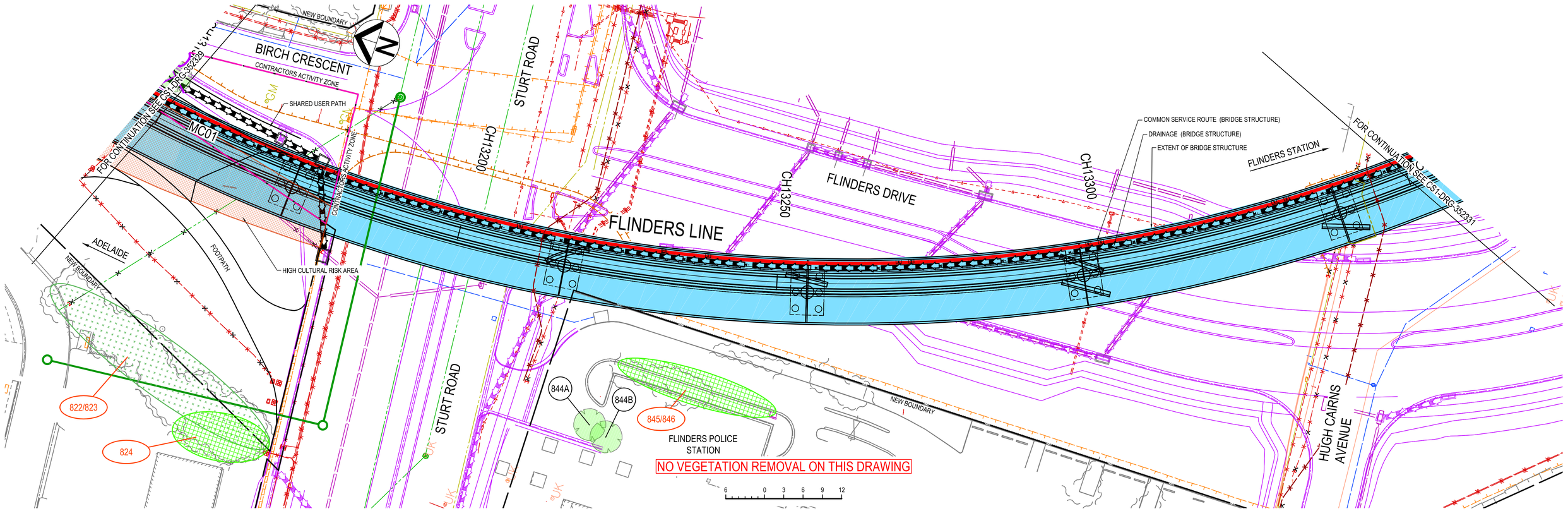


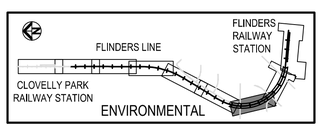


## NOTES (ENVIRONMENTAL):

1. TREE PROTECTION RE UIREMENTS TO BE ASSESSED AT TIME OF CONSTRUCTION BY SUPERINTENDENTS REPRESENTATIVE.
2. REFER TO VEGETATION SURVEY N . VS 2016/072 VS 2014/022 FOR INFORMATION ON EXISTING TREES.
3. REFER DPTI MASTER SPECIFICATION PART CH50 FOR THE ENVIRONMENTAL RE UIREMENTS.

## LEGEND (OTHER)

| SYMBOL | DESCRIPTION |
|---|---|
| | EXISTING SURVEY |
| | EXISTING SURVEY CONSTRUCTION WORKS CURRENTLY IN PROGRESS (BY OTHERS) |
| D D | VEGETATION AND TREE REMOVAL CURRENTLY IN PROGRESS (BY OTHERS) |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| 1 | VEGETATION SURVEY VS 2016/072 VS2014/022 TREE IDENTIFIER ( . TREE NUMBER 1 ) |
| | TREES TO BE REMOVED |
| 1 | SIGNIFICANT TREE |
| 1 | REGULATED TREE |
| 1 | AMENITY TREE |
| | HIGH CULTURAL RISK AREA |

## LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| ? | TREE REMOVAL TO BE ASSESSED AT TIME OF CONSTRUCTION BY OFFICERS FROM DPTI LANDSCAPE UNIT / ARBORIST |
| P | PRUNE |
| | VEGETATION TO BE REMOVED |
| 1 | AMENITY VEGETATION IDENTIFIER ( . AMENITY NUMBER 1 ) |
| | AMENITY TREE / SHRUBS |
| | AMENITY / DECLARED WEED PATCH |
| | AMENITY / WEED PATCH |

| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
|---|---|---|---|---|---|---|
| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

NOT FOR CONSTRUCTION

RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

| DRAFTING CHECK: | ORIGINATE/DESIGN: | INDEPENDENT CHECK: | TECHNICAL APPROVAL: | PROJECT APPROVAL: | DATE: |
|---|---|---|---|---|---|
| - | - | - | Z.BULL | D.RICHTER | 17.05.18 |

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TITLE: -
DATE: -

FLINDERS LINE
ENVIRONMENTAL
VEGETATION REMOVAL - SHEET 07
PLAN

Government of South Australia
Department of Planning, Transport and Infrastructure

CS1-DRG-352330

SCALE(S): 1:300 | SIZE: A1
REVISION: A | SHEET: 8 OF 10

CAD FILE NAME: CS1-DRG-352330.DWG PLOTTED: Thursday, 17 May 2018 12:00:57 PM

## NOTES (ENVIRONMENTAL):

1. TREE PROTECTION RE UIREMENTS TO BE ASSESSED AT TIME OF CONSTRUCTION BY SUPERINTENDENTS REPRESENTATIVE.
2. REFER TO VEGETATION SURVEY N . VS 2016/072 VS 2014/022 FOR INFORMATION ON EXISTING TREES.
3. REFER DPTI MASTER SPECIFICATION PART CH50 FOR THE ENVIRONMENTAL RE UIREMENTS.

### LEGEND (OTHER)

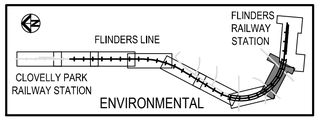
| SYMBOL | DESCRIPTION |
|---|---|
| | EXISTING SURVEY |
| | EXISTING SURVEY: CONSTRUCTION WORKS CURRENTLY IN PROGRESS (BY OTHERS) |
| D / D | VEGETATION AND TREE REMOVAL CURRENTLY IN PROGRESS (BY OTHERS) |

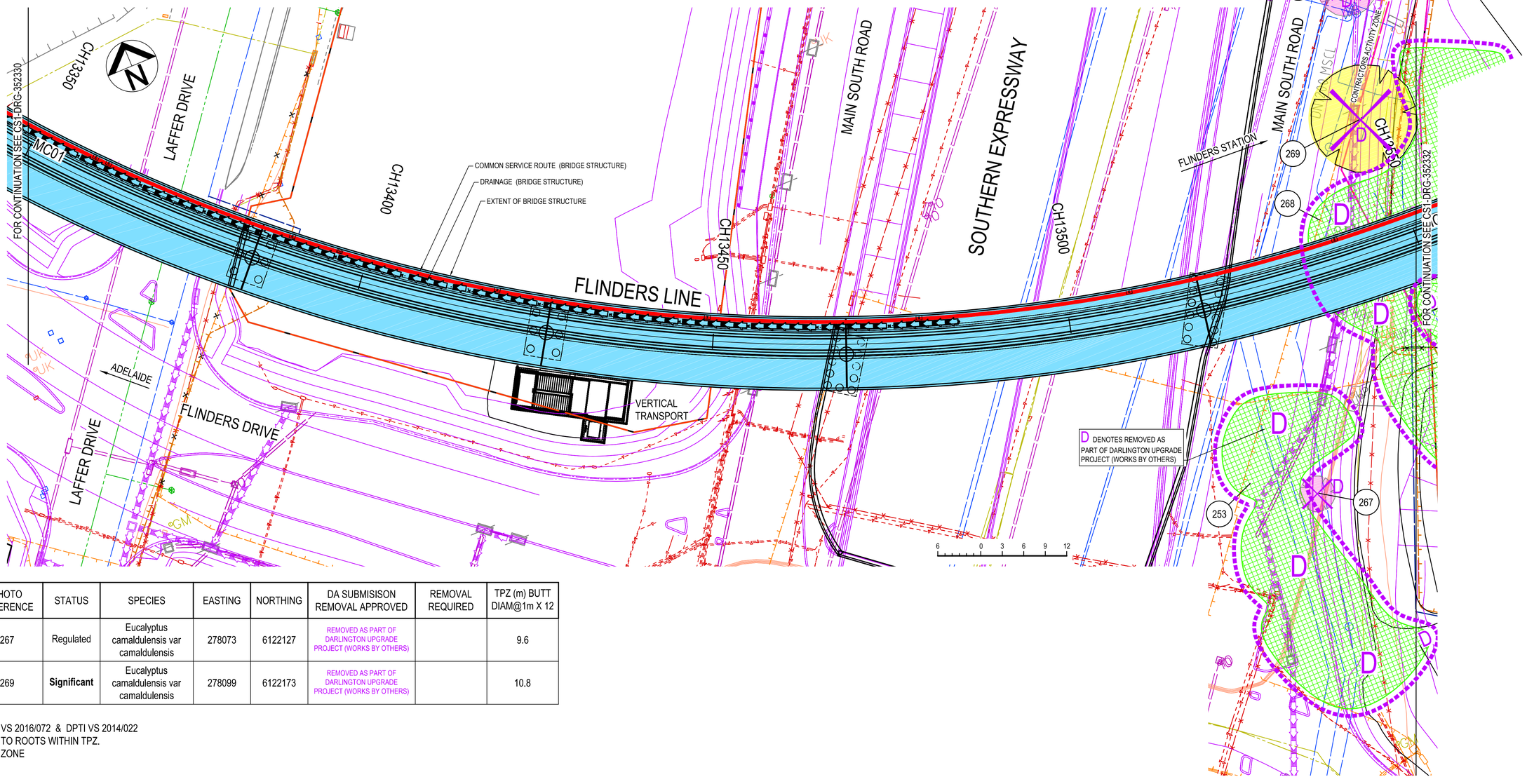
### LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| 1 | VEGETATION SURVEY VS 2016/072 VS2014/022 TREE IDENTIFIER ( . TREE NUMBER 1 ) |
| | TREES TO BE REMOVED |
| 1 | SIGNIFICANT TREE |
| 1 | REGULATED TREE |
| 1 | AMENITY TREE |
| | HIGH CULTURAL RISK AREA |

### LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| ? | TREE REMOVAL TO BE ASSESSED AT TIME OF CONSTRUCTION BY OFFICERS FROM DPTI LANDSCAPE UNIT / ARBORIST |
| P | PRUNE |
| | VEGETATION TO BE REMOVED |
| 1 | AMENITY VEGETATION IDENTIFIER ( . AMENITY NUMBER 1 ) |
| | AMENITY TREE / SHRUBS |
| | AMENITY / DECLARED WEED PATCH |
| | AMENITY / WEED PATCH |




| VEGETATION SURVEY | TREE MARKER ID | PHOTO REFERENCE | STATUS | SPECIES | EASTING | NORTHING | DA SUBMISISON REMOVAL APPROVED | REMOVAL REQUIRED | TPZ (m) BUTT DIAM@1m X 12 |
|---|---|---|---|---|---|---|---|---|---|
| VS 2014/022 | 267 | 267 | Regulated | Eucalyptus camaldulensis var camaldulensis | 278073 | 6122127 | REMOVED AS PART OF DARLINGTON UPGRADE PROJECT (WORKS BY OTHERS) | | 9.6 |
| VS 2014/022 | 269 | 269 | **Significant** | Eucalyptus camaldulensis var camaldulensis | 278099 | 6122173 | REMOVED AS PART OF DARLINGTON UPGRADE PROJECT (WORKS BY OTHERS) | | 10.8 |

NOTE:
S1 FOR PHOTO REFERENCE , SEE DPTI VS 2016/072 & DPTI VS 2014/022
S2 "PRUNE" ALSO RELATED TO IMPACT TO ROOTS WITHIN TPZ.
S3 "TPZ" DENOTES TREE PROTECTION ZONE

| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
|---|---|---|---|---|---|---|
| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

NOT FOR CONSTRUCTION

RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

| DRAFTING CHECK: | ORIGINATE/DESIGN: | INDEPENDENT CHECK: | TECHNICAL APPROVAL: | PROJECT APPROVAL: | DATE: |
|---|---|---|---|---|---|
| - | - | - | Z.BULL | D.RICHTER | 17.05.18 |

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APPROVED: -
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DATE: -

FLINDERS LINE
ENVIRONMENTAL
VEGETATION REMOVAL - SHEET 08
PLAN

Government of South Australia
Department of Planning, Transport and Infrastructure

CS1-DRG-352331

SCALE(S): 1:300 | SIZE: A1
REVISION: A | SHEET: 9 OF 10

CAD FILE NAME: CS1-DRG-352331DWG PLOTTED: Thursday, 17 May 2018 12:01:19 PM

## NOTES (ENVIRONMENTAL):

1. TREE PROTECTION RE UIREMENTS TO BE ASSESSED AT TIME OF CONSTRUCTION BY SUPERINTENDENTS REPRESENTATIVE.
2. REFER TO VEGETATION SURVEY N . VS 2016/072 VS 2014/022 FOR INFORMATION ON EXISTING TREES.
3. REFER DPTI MASTER SPECIFICATION PART CH50 FOR THE ENVIRONMENTAL RE UIREMENTS.

### LEGEND (OTHER)

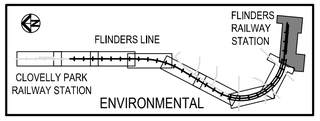
| SYMBOL | DESCRIPTION |
|---|---|
| | EXISTING SURVEY |
| | EXISTING SURVEY CONSTRUCTION WORKS CURRENTLY IN PROGRESS (BY OTHERS) |
| D D | VEGETATION AND TREE REMOVAL CURRENTLY IN PROGRESS (BY OTHERS) |

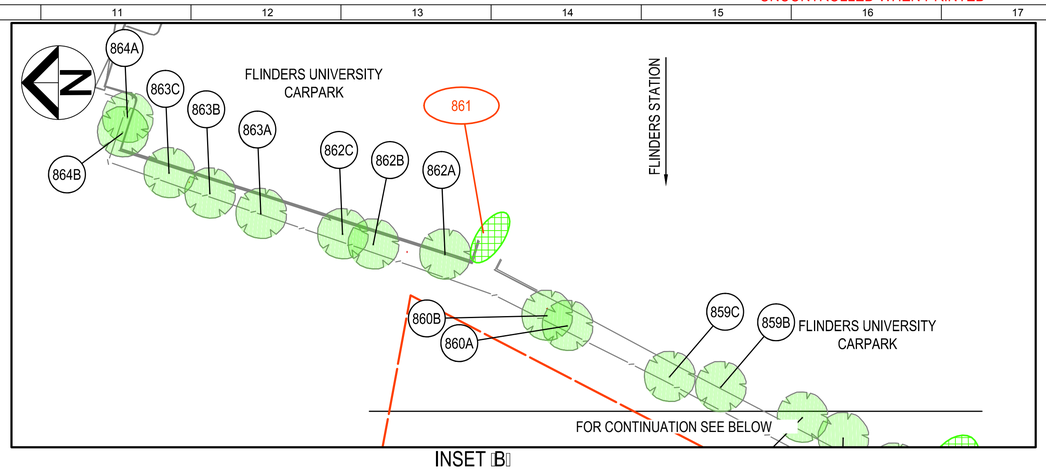
### LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| 1 | VEGETATION SURVEY VS 2016/072 VS2014/022 TREE IDENTIFIER (. . TREE NUMBER 1 ) |
| | TREES TO BE REMOVED |
| 1 | SIGNIFICANT TREE |
| 1 | REGULATED TREE |
| 1 | AMENITY TREE |
| | HIGH CULTURAL RISK AREA |

### LEGEND (ENVIRONMENTAL)

| SYMBOL | DESCRIPTION |
|---|---|
| ? | TREE REMOVAL TO BE ASSESSED AT TIME OF CONSTRUCTION BY OFFICERS FROM DPTI LANDSCAPE UNIT / ARBORIST |
| P | PRUNE |
| | VEGETATION TO BE REMOVED |
| 1 | AMENITY VEGETATION IDENTIFIER (. . AMENITY NUMBER 1 ) |
| | AMENITY TREE / SHRUBS |
| | AMENITY / DECLARED WEED PATCH |
| | AMENITY / WEED PATCH |

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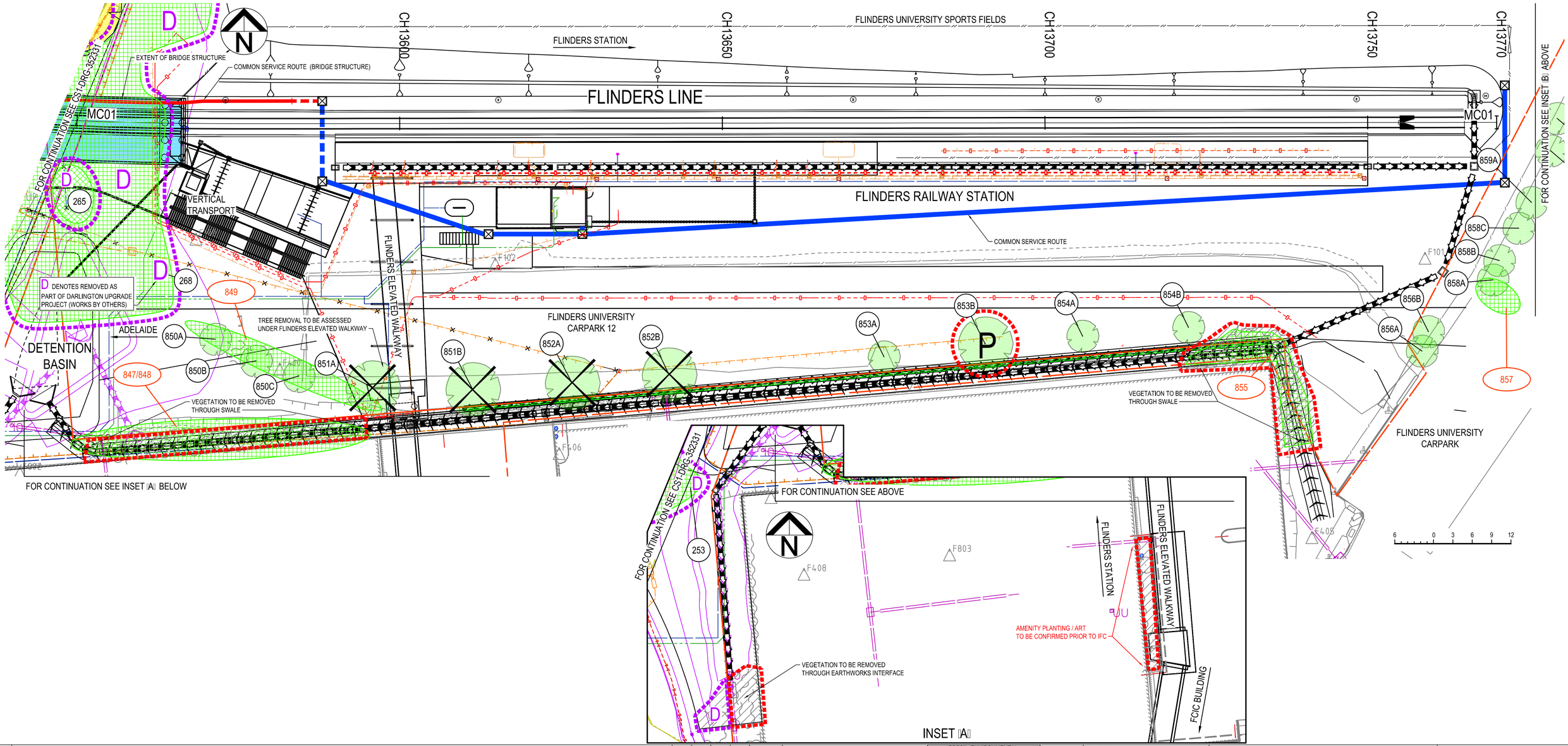


| REV | DESCRIPTION | DRN | DSGN | CHK | APRV | DATE |
|---|---|---|---|---|---|---|
| A | ISSUED FOR 70% REVIEW | - | - | - | - | 17.05.18 |

NOT FOR CONSTRUCTION

RDP25 - ENVIRONMENTAL

GATEWAY SOUTH

INDEX SHEET REF: CS1-DRG-352323

| DRAFTING CHECK: | ORIGINATE/DESIGN: | INDEPENDENT CHECK: | TECHNICAL APPROVAL: | PROJECT APPROVAL: | DATE: |
|---|---|---|---|---|---|
| - | - | - | Z.BULL | D.RICHTER | 17.05.18 |

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TITLE: -
DATE: -

FLINDERS LINE
ENVIRONMENTAL
VEGETATION REMOVAL - SHEET 09
PLAN

Government of South Australia
Department of Planning, Transport and Infrastructure

CS1-DRG-352332

SCALE(S): 1:300 | SIZE: A1
REVISION: A | SHEET: 10 OF 10

CAD FILE NAME: CS1-DRG-352332.DWG PLOTTED: Thursday, 17 May 2018 12:46:19 PM

Resonate

# Flinders Link

## 30% Design Noise Assessment Report

A17715RP2 Revision D

Thursday, 10 May 18

Resonate

**Document Information**

| | | |
|---|---|---|
| **Project** | Flinders Link - Detailed Design | |
| **Client** | Jacobs Group Australia Pty Ltd | |
| **Report title** | 30% Design Noise Assessment Report | |
| **Project Number** | A17715 | |
| **Author** | Nick Henrys<br>Team Leader—Acoustics SA<br>p+61 8 8155 5888<br>m+61 481 882 689<br>nick.henrys@resonate-consultants.com |  |
| **Reviewed by** | Darren Jurevicius | |

**Revision Table**

| Report revision | Date | Comments |
|---|---|---|
| A | 19 December 2017 | DRAFT |
| B | 20 December 2017 | Final Issue |
| C | 1 February 2018 | Revised in Response to DPTI Comments |
| D | 10 May 2018 | Revised in Response to DPTI Comments |
| | | |
| | | |

# Glossary

| | |
|---|---|
| A-weighting | A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies. |
| Day | Between 7 am and 10 pm as defined in the RTNG and GANRI. |
| dB | Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy. We typically perceive a 10 dB increase in sound as a doubling of that sound level. |
| dB(A) | Units of the A-weighted sound level. |
| DPTI | Department of Planning, Transport and Infrastructure. |
| GANRI | SA EPA *Guidelines for the assessment of noise from rail infrastructure*. |
| Insertion Loss (IL) | The insertion loss of a barrier is the difference in sound pressure levels at a specified receiver position before and after the installation of the barrier, provided that the noise source, terrain profiles, interfering obstructions and reflecting surfaces (if any) have not changed. |
| $L_{eq}$ | Equivalent Noise Level—Energy averaged noise level over the measurement time. |
| $L_{eq,15h}$ | Daytime road or rail traffic level, determined as the equivalent noise level from road or rail traffic over the daytime period. |
| $L_{eq,9h}$ | Night time road or rail traffic level, determined as the equivalent noise level from road or rail traffic over the night time period. |
| $L_{max}$ | Maximum noise level measured in a time period. Used to assess noise levels from individual train pass-bys. |
| mm/s | Millimetres per second, unit of vibration velocity. |
| Night | Between 10 pm on one day and 7 am on the following day as defined in the RTNG and GANRI. |
| Peak Particle Velocity (PPV) | The maximum speed of a particle in a particular component direction due to vibration during a measurement. |
| rms | Root-mean-square. |
| Residual exceedance | The remaining exceedance of a noise assessment criterion following the application of noise mitigation measures. |
| RTNG | DPTI *Road Traffic Noise Guidelines* |
| $R_W$ | Weighted Sound Reduction Index—A laboratory measured value of the acoustic separation provided by a single building element (such as a partition). The higher the $R_W$ the better the noise isolation provided by a building element. |
| $R_w + C_{tr}$ | A measure of the sound insulation performance of a building element with a $C_{tr}$ spectrum adaptation term placing greater emphasis on the low frequency performance. |
| SEL | Sound Exposure Level—the sound pressure level of an event within a defined duration, normalised to a duration of one second. |

Resonate

# Table of Contents

# 1 Introduction

The Australian and South Australian Governments have committed $85 million to construct the Flinders Link Project. The Project is an extension of the existing Tonsley Passenger Rail Line to Flinders Medical Centre, creating new connections to the health precinct and Flinders University.

The project includes:

- A 650 metre extension of the Tonsley Passenger Rail Line linking the Flinders Medical Centre and Flinders University to the rail network, including 420 metres of elevated single track over Sturt Road, Laffer's Road and Main South Road
- A new station next to the Flinders Medical Centre
- An integrated shared pedestrian/cycle path adjacent to the rail line.

The operational phase of the project will have potential rail traffic noise impacts on noise sensitive receivers adjacent to the project area. These impacts require assessment against relevant guidelines for rail traffic noise.

This report is the Noise Assessment Report for the Flinders Link Project based on the 30% design. It presents:

- The relevant rail noise assessment criteria for the project.
- Predicted rail noise levels at noise sensitive receivers adjacent to the project for the existing and project opening scenarios.

# 2 Assessment Criteria

## 2.1 General environmental duty

Under the South Australian *Environment Protection Act 1993* (EP Act), the Flinders Link Project has a duty of care for the environment due to rail infrastructure works. This *General Environmental Duty* is defined in Section 25 of the EP Act as:

> *A person must not undertake an activity that pollutes, or might pollute, the environment unless that person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.*

As discussed in the following sections, guidelines produced for management of rail noise provide guidance as to the requirements for satisfying the *General Environmental Duty* as part of a transport infrastructure project.

## 2.2 Rail noise

The South Australian EPA has developed the *Guidelines for the assessment of noise from rail infrastructure* (GANRI). GANRI was released in April 2013, and specifies the assessment methodology and noise and vibration criteria for rail infrastructure projects, and is therefore relevant to the Flinders Link Project.

### 2.2.1 Rail noise criteria

Table 1 presents the rail noise criteria relevant for noise-sensitive receivers adjacent to the Flinders Link project. GANRI requires compliance with the noise criteria to be achieved both at project opening and 10 years into the future.

**Table 1 Rail noise assessment criteria**

| Sensitive receiver | Type of project | Noise criteria, dB(A) | |
|---|---|---|---|
| | | Day | Night |
| Residential | Upgraded rail line | 65 $L_{eq,15h}$ | 60 $L_{eq,9h}$ |
| | | 85 $L_{max}$ OR<br>No increase on existing, whichever is the greater | 85 $L_{max}$ OR<br>No increase on existing, whichever is the greater |
| | New railway line | 60 $L_{eq,15h}$ | 55 $L_{eq,9h}$ |
| | | 80 $L_{max}$ | 80 $L_{max}$ |
| Hospitals | New railway line | 60 $L_{eq,1h}$ | |
| Educational Institutions | New railway line | 65 $L_{eq,15h}$ | N/A |
| Active recreation areas such as sporting fields | New railway line | 65 $L_{eq,15h}$ | N/A |

Receivers to the north of Sturt Road are assessed against the upgraded rail line criteria in accordance with GANRI, while receivers to the south of Sturt Road are assessed against new railway line criteria.

We note that the Sturt Police Station and other commercial buildings to the west of the proposed viaduct are not considered to be noise sensitive receivers in accordance with GANRI. The Mark Oliphant Building at 5 Laffer Drive, Bedford Park is owned by Flinders University and has been assessed as an Educational Institution.

## 2.3 Noise assessment location

It is a requirement of the GANRI that noise levels are predicted at a position one metre from the facade of each noise sensitive building at a height of 1.5 metres above each floor level. The noise assessment location should correspond to a facade where a door or window to a noise sensitive area is contained. Note that a facade where no windows/doors exist or where the only windows serve non-sensitive areas such as bathrooms should not be treated as noise sensitive.

Noise levels at these locations are influenced by reflections from the building facade, and all predictions are to include a facade reflection factor. For rail noise, a conservative reflection factor of +3 dB has been applied in accordance with the rail noise prediction methodology recommended by GANRI.

Each floor level of a multi-storey building has also been considered separately when predicting noise levels for comparison against the applicable noise criteria.

For active and passive recreation areas, the assessment location should be at the most affected location of the recreation area, and no facade reflection factor will be applicable.

# 3 Existing environment

## 3.1 Noise sensitive receivers

The primary noise sensitive receivers relevant to the Flinders Link Project are residential properties in the suburbs of Mitchell Park and Clovelly Park. Other than residential properties, the Flinders Medical Centre and Sports Fields are located near the terminus and proposed new station.

As noted in Section 2.2.1, the Sturt Police Station and other commercial buildings are not considered noise sensitive receivers according to GANRI.

Noise sensitive receiver locations and IDs are shown on the Figure in Appendix A.

## 3.2 Existing noise environment

The existing noise environment in the project area varies over the project site. Residences in Mitchell Park and Clovelly Park are currently controlled by rail noise from the existing Tonsley Passenger Rail Line, station and associated activities including car parking; in addition to local road traffic. South of Sturt Road, the noise environment is controlled by road traffic noise from Sturt Road and South Road, with no existing rail noise.

The existing rail noise levels at the residential locations are controlled by the distance between the residence and the Tonsley Passenger Rail Line, and the presence of any intervening structures.

### 3.2.1 Rail noise

Ambient rail noise levels were measured by AECOM in 2010 at three locations along the existing Tonsley line as part of the Darlington Transport Study. Median rail noise levels from measurements adjacent the Tonsley Passenger Rail Line are presented in Table 2.

**Table 2 Measured existing noise levels in project area**

| Catchment Area | Description | Measured noise level, dB(A) | |
|---|---|---|---|
| | | Day $L_{eq,15h}$ | Night $L_{eq,9h}$ |
| A | Adjacent existing Tonsley Passenger Rail Line from Woodlands Park railway station to Sturt Road | 52 | 47 |

Maximum levels ($L_{max}$) were reported at the nearest properties to the Tonsley Passenger Rail Line to range from 82 to 87 dB(A). Daytime noise levels ($L_{eq,15hr}$) at the nearest properties were stated to range from 53 to 56 dB(A). As the Tonsley Passenger Rail Line currently is in service only between 7am and 7pm, there is no significant night time rail noise within the study area.

Note that the measured daytime noise levels may be influenced to some degree by extraneous noise from local traffic, birds and wind in the trees.

# 4 Rail noise assessment methodology

Rail noise models were developed for the Flinders Link Project for the following scenarios:

- Existing scenario – year 2017
- Project opening scenario – year 2019.

Both the project opening and existing scenario have been modelled with the existing Adelaide Metro A-City Class 4000 Electric Multiple Units (EMUs), assuming three car sets.

We note that 3000 Class Diesel Railcars may be used on rare occasions (for example in the event of a line fault). We understand that the frequency of use is expected to be very low, such that an assessment of noise emissions from 3000 Class trains is not warranted.

A future 2029 scenario has not been modelled at this stage as the opening scenario will be representative of the future scenario. The current operating conditions of one train movement in each direction per 30 minute period however we understand that the capacity of the line is one train movement per 20 minutes in each direction.

## 4.1 Project assessment area

The Flinders Link project will involve a considerable vertical realignment of the Tonsley Passenger Rail Line near the current Tonsley Station. The rail line will then extend as an elevated structure over Sturt Road, Laffer Drive and Main South Road before terminating north of the Flinders Medical Centre.

The project assessment area for rail noise and vibration considers the area between the start of works near Woodland Road in Mitchell Park, through to the Flinders Medical Centre in Bedford Park.

## 4.2 Prediction methodology and model inputs

Rail noise predictions for existing and future scenarios have been carried out using the Nordic Rail Prediction Method (Kilde Report 130), as implemented by SoundPlan software version 7.4. The Nordic Rail Prediction Method is specified as a suitable method for the prediction of $L_{eq}$ and $L_{max}$ rail noise levels by GANRI.

The inputs included in the three-dimensional SoundPlan noise models were:

- +3 dB facade reflection factor in accordance with the Nordic Rail Prediction Method
- topographical contours provided by Gateway South
- existing rail alignment from the topographical contours and aerial photography
- rail alignment and viaduct cross section information provided by Jacobs Group
- continuously welded rail for the rail structure
- 50% absorptive ground
- building footprints from aerial photography and building heights based on surveys of the site
- existing fences based on surveys of the site.

## 4.3 Calibration

The Nordic Rail Prediction Method algorithms predict noise levels based on the number, speed and length of trains, and require calibration to site conditions. Noise levels from 4000 class trains were previously measured by Resonate to calibrate the predicted noise levels. The measured reference Sound Exposure Level (SEL) and $L_{max}$ level used to calibrate the rail noise model are presented in Table 3.

**Table 3 Reference train noise levels for calibration**

| Train | Reference distance | Reference speed | SEL, dB(A) | $L_{max}$, dB(A) |
|---|---|---|---|---|
| 4000 class | 20 m | 70 km/h | 84 | 80 |

Noise from the 4000 class passenger trains comprise of noise from the rolling stock on the track. Rolling stock source has been located at 0.5 m above ground.

## 4.4 Train volumes, lengths and speeds

Table 4 presents the train volumes, lengths and speeds for the two noise modelling scenarios carried out for Flinders Link.

**Table 4 Train volumes, lengths and speeds for noise modelling**

| Scenario | Track direction | Speed, km/h | Length, m | Train movements | |
|---|---|---|---|---|---|
| | | | | Day | Night |
| Existing | Up (to Adelaide) | 70 | 75 | 24 | 0 |
| | Down (from Adelaide) | 70 | 75 | 24 | 0 |
| Project opening (2019) | Up | 60-70 | 75 | 36 | 0 |
| | Down | 60-70 | 75 | 36 | 0 |

The existing data has been based on the current Tonsley Rail Line timetables (February 2015). We understand that train frequencies on the line may increase from 30 minutes to 20 minutes in the future. It is assumed that this is the case for the project opening (2019) scenario. It has been assumed that service will remain within the daytime hours of 7am to 10pm only.

The design speed of the viaduct is understood to be 50 km/h. We have assumed this speed on the viaduct and Flinders Station (Terminus) sections and 70 km/h on the at-grade section north of the viaduct.

## 4.5 Curve squeal

Curve squeal (sometimes referred to as wheel squeal) occurs where there is a relatively tight radius to negotiate such as on the viaduct section of the Flinders Link proposal. Further discussion including mitigation measures described in Section 7 of this report, entitled Rail Noise Mitigation, and the Resonate report *Curve Squeal Risk and Mitigation Measures*.

Measurements taken by Sydney Trains (formerly RailCorp) at a 284 m radius curve at Beecroft, NSW, indicate that maximum noise levels from passenger train movements are between 6 and 15 dB higher than noise levels from the same trains on straight track sections.

The noise model includes the following allowances (independent of speed) for localised increase in noise emission on the curved section of track assuming no curve squeal mitigation:

- +5 dB $L_{AE}$
- +14 dB $L_{Amax}$

The above adjustments are consistent with modelling recently carried out by SLR for the Epping to Thornleigh Third Track Project in NSW, on similar radius curves.

## 4.6 Structure-borne noise

Structure-borne noise refers to rail vibration regenerated as airborne noise by the bridge structure. This can both increase the received noise level at residences adjacent to the bridge structure and change the character of the noise. Structure-borne noise from steel box structures tends towards the lower frequencies and can be tonal in nature[1], with tonal noise having the potential to increase annoyance for the same overall level of noise. Note that structure-borne noise is different to ground-borne vibration.

The level and character of structure-borne noise will depend on the structure of the bridge, the track construction and the type and speed of trains passing over.

Figure 1 compares the level of structure-borne and airborne noise for different bridge structures from the *Handbook of Engineering Acoustics*[2]. It can be seen that the steel bridges result in higher levels than concrete structures. The presence of noise at 63 Hz corresponds to a speed-dependent relationship between the train and the structure and will therefore vary between situations.

[1] Ngai KW & Ng CF, 2002, *Structure-Borne Noise and Vibration of Concrete Box Structure and Rail Viaduct*, Journal of Sound and Vibration, Vol 255(2), pp 281—297.

[2] Müller G & Möser M (eds), 2012, *Handbook of Engineering Acoustics*, Chapter 16.

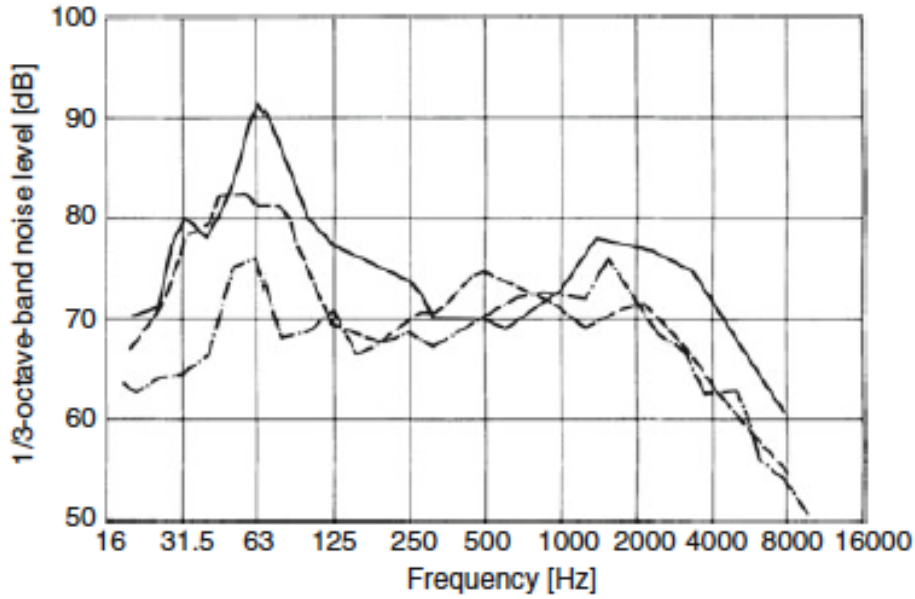


**Fig. 16.21** Airborne noise at a distance of 25 m to the side of three bridges of different types of construction with ballasted track during the drive over of passenger trains with disc brakes at a speed of approx. 130 km/h: ——— steel hollow-box girder bridge, measurement height 1.5 m above top of rail: 97 dB(lin), 87 dB(A); - - - - - - - steel lattice-girder bridge, measurement height 3.5 m above top of rail: 89 dB(lin), 80 dB(A); —·—·— reinforced concrete hollow-box girder bridge, measurement height 3.5 m above top of rail: 85 dB (lin), 82 dB(A)

**Figure 1 Comparison of structure-borne and airborne noise for different bridge structures from *Handbook of Engineering Acoustics* (Fig. 16.21)**

A recent study, conducted for the Glenelg Tram Overpass of South Road, considered the relative contribution of structure-borne noise and airborne noise based on measurements conducted at the older tram line overpass at Goodwood which had no specific structure-borne noise mitigation included in the design. It was found that the overall contribution of structure-borne noise was broadly similar to airborne noise at the older structure and therefore, if noise mitigation was required as part of the new overpass design, it would be necessary to mitigate both structure-borne noise and airborne noise.

To reduce structure-borne noise (or bridge-borne noise), which cannot be mitigated via railside noise barriers, being emitted via vibration transmission to the overpass structure, it is important that vibration isolation is included between the rail and the overpass structure.

The rail noise predictions for the Flinders Link project have been prepared on the basis that the track will be installed on a concrete slab with vibration isolation installed between the rail and the slab. It is understood that Pandrol Vipa SP will be installed.

An adjustment of +4 dB has been applied in accordance with the *NSW Rail Noise Database: Stage III Measurements and Analysis* (January 2015). A more accurate adjustment for bridge noise radiation can be determined with detailed modelling if necessary.

# 5 Existing rail noise levels

Table 5 presents the modelled existing rail noise levels for each noise sensitive receiver within the project assessment area.. The location of each receiver is shown in Appendix A.

Modelled noise levels at each receiver are shown in Table 5 below, and noise contour maps are shown in Appendix C. The modelled existing rail noise levels indicate that noise sensitive receivers located adjacent to the Tonsley Passenger Rail Line are currently exposed to day time rail noise levels in the order of 50 to 55 dB(A) $L_{eq,15h}$ and maximum noise levels of 76 to 83 dB(A) $L_{max}$.

All residential properties assessed are exposed to existing rail noise levels, and as such, the upgraded rail line criteria from GANRI is applicable.

**Table 5 Predicted existing rail noise levels**

| Location | Receiver ID | Predicted existing rail noise levels, dB(A) | |
|---|---|---|---|
| | | Day $L_{eq,15h}$ | $L_{max}$ |
| Woodland Road and Timothy Court | RA031 | 44 | 73 |
| | RA032 | 43 | 71 |
| | RA033 | 49 | 77 |
| | RA034 | 49 | 77 |
| | RA035 | 49 | 77 |
| | RA036 | 50 | 78 |
| | RA037 | 50 | 78 |
| | RA038 | 50 | 78 |
| | RA039 | 50 | 78 |
| | RA040 | 50 | 77 |
| | RA041 | 49 | 77 |
| Lynton Avenue | RA042 | 46 | 74 |
| | RA043 | 48 | 76 |
| | RA044 | 48 | 75 |
| | RA045 | 48 | 75 |
| | RA001 | 45 | 71 |
| | RA002 | 45 | 71 |
| | RA003 | 44 | 72 |
| | RA004 | 44 | 72 |
| | RA005 | 47 | 74 |
| | RA006 | 44 | 71 |
| | RA007 | 44 | 71 |
| | RA012 | 39 | 70 |

| Location | Receiver ID | Predicted existing rail noise levels, dB(A) | |
|---|---|---|---|
| | | Day $L_{eq,15h}$ | $L_{max}$ |
| Chestnut Court | RA016 | 44 | 72 |
| | RA018 | 47 | 75 |
| Ash Avenue and Birch Crescent | RA019 | 50 | 77 |
| | RA021 | 51 | 77 |
| | RA022 | 52 | 79 |
| | RA023 | 53 | 80 |
| | RA024 | 53 | 81 |
| | RA025 | 55 | 82 |
| | RA026 | 55 | 84 |
| | RA014 | 56 | 84 |
| | RA027 | 55 | 84 |
| | RA028 | 55 | 84 |
| | RA029 | 55 | 83 |
| | RA030 | 54 | 83 |
| | RA008 | 53 | 82 |
| | RA009 | 53 | 82 |
| | RA010 | 52 | 82 |
| | RA011 | 47 | 78 |
| | RA013 | 44 | 74 |
| | RA046 | 40 | 70 |

# 6 Future rail noise levels

This Section presents predicted rail noise levels for the 30% Flinders Link design. Corrections for curve squeal and structure-borne noise have been applied to emissions from the viaduct as described in Sections 4.5 and 4.6. These include a theoretical upward adjustment of 4dB(A) in the absence of more detailed modelling.

## 6.1 2019 rail noise levels without mitigation

Table 6 presents the predicted 2019 rail noise levels for each noise sensitive receiver within the project assessment area with no noise mitigation. Noise contour maps are presented in Appendix C.

Predicted noise levels that exceed the relevant upgraded rail line criteria from GANRI of 65 dB(A) $L_{eq,15h}$ or 85 dB(A) $L_{max}$ are highlighted in bold type.

**Table 6 Predicted 2019 rail noise levels without mitigation**

| Location | Receiver ID | Predicted 2019 rail noise levels with no barriers, dB(A) | |
|---|---|---|---|
| | | Day $L_{eq,15h}$ | $L_{max}$ |
| Woodland Road and Timothy Court | RA031 | 54 | 79 |
| | RA032 | 54 | 80 |
| | RA033 | 54 | 77 |
| | RA034 | 54 | 78 |
| | RA035 | 55 | 77 |
| | RA036 | 57 | 80 |
| | RA037 | 57 | 79 |
| | RA038 | 57 | 80 |
| | RA039 | 57 | 80 |
| | RA040 | 57 | 80 |
| | RA041 | 56 | 81 |
| Lynton Avenue | RA042 | 59 | 84 |
| | RA043 | 58 | 81 |
| | RA044 | 57 | 81 |
| | RA045 | 60 | 86 |
| | RA001 | 59 | 85 |
| | RA002 | 59 | 84 |
| | RA003 | 61 | **86** |
| | RA004 | 61 | **86** |
| | RA005 | 60 | 85 |
| | RA006 | 59 | 84 |

| Location | Receiver ID | Predicted 2019 rail noise levels with no barriers, dB(A) | |
|---|---|---|---|
| | | Day $L_{eq,15h}$ | $L_{max}$ |
| | RA007 | 59 | 84 |
| | RA012 | 58 | 82 |
| Chestnut Court | RA016 | 47 | 70 |
| | RA018 | 49 | 73 |
| Ash Avenue and Birch Crescent | RA019 | 54 | 78 |
| | RA021 | 54 | 77 |
| | RA022 | 55 | 79 |
| | RA023 | 56 | 79 |
| | RA024 | 56 | 80 |
| | RA025 | 57 | 83 |
| | RA026 | 58 | 83 |
| | RA014 | 59 | 83 |
| | RA027 | 58 | 83 |
| | RA028 | 59 | 82 |
| | RA029 | 60 | 82 |
| | RA030 | 60 | 83 |
| | RA008 | 63 | **87** |
| | RA009 | 65 | **91** |
| | RA010 | **66** | **91** |
| | RA011 | 65 | **89** |
| | RA013 | 64 | **89** |
| | RA046 | 60 | 82 |
| Flinders Sports Fields | | 49 | N/A |
| Flinders Medical Centre | | 52 (Max $L_{eq,1hr}$) | N/A |

The predictions indicate that, without additional mitigation measures, the current rail overpass design is predicted to result in exceedances of the upgraded rail line $L_{max}$ criteria at seven residences located on both sides of the Tonsley Passenger Rail Line. The exceedances of the $L_{max}$ noise criteria range from 1 to 6 dB. At one residence the $L_{eq}$ criteria is also exceeded by 1 dB.

The predicted increase in $L_{max}$ noise levels compared to the existing scenario is primarily due to potential additional noise from curve squeal from the tight radius curve, and structure-borne noise due to the steel viaduct structure. The predicted increase in $L_{eq}$ noise levels compared to the existing scenario is primarily due to the increase in train frequency and changes in the track alignment.

Noise contour maps showing the predicted future 2019 rail noise levels are included in Appendix B.

# 7 Rail noise mitigation

This section describes the noise mitigation assessment undertaken to address rail noise associated with the 30% Flinders Link design.

## 7.1 Curve squeal

The assessment of predicted 2019 maximum noise levels ($L_{max}$) showed that some receivers could be in excess of the upgraded rail line criteria of 85 dB(A) $L_{Max}$ by up to 6 dB without mitigation. This exceedance was primarily driven by curve squeal over the section of tight curvature, where considerable adjustments or penalties are applied in the model to account for the additional noise.

As described in the Resonate Report *Curve Squeal Risk and Mitigation Measures*, a friction modification system is recommended to mitigate curve squeal noise. However, it is noted that even in successful applications of such systems, curve squeal noise has not generally been eliminated, but rather reduced.

Notwithstanding the above, Table 7 presents the predicted 2019 rail noise levels for each noise sensitive receiver within the project assessment area, with no adjustments applied for curve squeal (i.e. assuming that curve squeal is able to be eliminated).

**Table 7 Predicted 2019 rail noise levels with curve squeal mitigation**

| Location | Receiver ID | Predicted 2019 rail noise levels with no curve squeal, dB(A) | |
|---|---|---|---|
| | | Day $L_{eq,15h}$ | $L_{max}$ |
| Woodland Road and Timothy Court | RA031 | 53 | 79 |
| | RA032 | 54 | 80 |
| | RA033 | 53 | 77 |
| | RA034 | 53 | 78 |
| | RA035 | 54 | 77 |
| | RA036 | 56 | 80 |
| | RA037 | 56 | 79 |
| | RA038 | 56 | 80 |
| | RA039 | 56 | 80 |
| | RA040 | 56 | 80 |
| | RA041 | 56 | 81 |
| Lynton Avenue | RA042 | 58 | 84 |
| | RA043 | 56 | 81 |
| | RA044 | 56 | 81 |
| | RA045 | 57 | 81 |
| | RA001 | 55 | 80 |
| | RA002 | 54 | 78 |

| Location | Receiver ID | Predicted 2019 rail noise levels with no curve squeal, dB(A) | |
|---|---|---|---|
| | | Day $L_{eq,15h}$ | $L_{max}$ |
| | RA003 | 54 | 79 |
| | RA004 | 55 | 81 |
| | RA005 | 56 | 82 |
| | RA006 | 53 | 77 |
| | RA007 | 53 | 76 |
| | RA012 | 50 | 74 |
| Chestnut Court | RA016 | 46 | 70 |
| | RA018 | 49 | 73 |
| Ash Avenue and Birch Crescent | RA019 | 54 | 78 |
| | RA021 | 54 | 77 |
| | RA022 | 55 | 79 |
| | RA023 | 55 | 79 |
| | RA024 | 56 | 80 |
| | RA025 | 57 | 83 |
| | RA026 | 58 | 83 |
| | RA014 | 58 | 83 |
| | RA027 | 57 | 83 |
| | RA028 | 58 | 82 |
| | RA029 | 58 | 82 |
| | RA030 | 57 | 82 |
| | RA008 | 57 | 82 |
| | RA009 | 58 | 83 |
| | RA010 | 59 | 84 |
| | RA011 | 57 | 82 |
| | RA013 | 56 | 81 |
| | RA046 | 52 | 77 |
| Flinders Sports Fields | | 47 | N/A |
| Flinders Medical Centre | | 52 (Max $L_{eq,1hr}$) | N/A |

The predictions indicate that in the event that curve squeal noise is eliminated, noise levels are expected to comply with GANRI criteria at all noise sensitive locations. However, as noted above, it is not considered likely that curve squeal noise will be completely eliminated with the use of track/wheel friction modifiers.

The predictions have not been further modelled and cannot be tested until the rail is in operation. There are various means to mechanically reduce wheel squeal which will be employed on site. There are other techniques to mitigate effects of noise including at or near source and at the receiver. Preference according to GANRI is source treatment, followed by mitigation along the transmission path, such as the installation of a noise barrier.

However, in situations where noise barriers are not reasonable and practicable due to visual, safety, cost or other constraints, treatments to affected individual receivers are an acceptable alternative or supplementary mitigation measure.

## 7.2 Noise barriers

Noise barriers within the rail corridor are one option to mitigate the risk of curve squeal noise, in addition to rolling noise. The proposed extent of noise barriers is shown in Appendix B. The effectiveness of noise barriers is dependent on their height and location in relation to the source and receiver, with barriers close to the source generally providing the greatest noise reduction.

We have assumed 1.8m vertical barriers at the rail fence as shown in Figure 2 below. Concrete barriers have been assumed in the noise model, however other materials may be used provided they have a surface mass of at least 15 kg/m$^2$ and are constructed without gaps between panels. Alternative locations of barriers (for example on the outside of the shared pedestrian and cycling path) may also be considered, although the required minimum height is likely to increase if the barriers are located further from the noise source.

Application of acoustic absorption (for example Pyrotek Reapor or similar) to the inside face will increase the level of noise reduction.

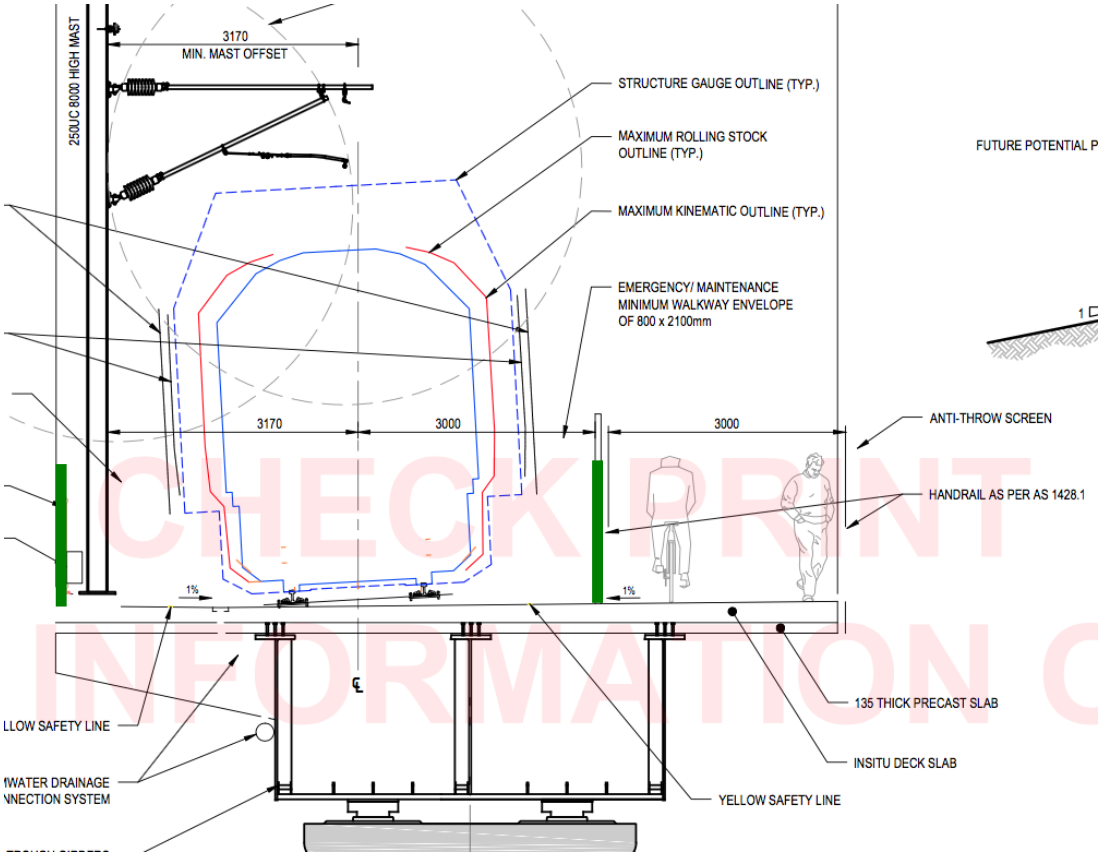


**Figure 2 Modelled barrier height and location.**