ENGENY

KNOX CITY COUNCIL

Koolunga Native Reserve

Koolunga Stormwater Quality Study

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19 APRIL 2023

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Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	7/12/2022	Draft Report	Lola Nurhalim	Scott Dunn	Lola Nurhalim	Scott Dunn
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3	19/04/2023	Client Issue	Lola Nurhalim	Scott Dunn	Lola Nurhalim	Scott Dunn
Signatures:						

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1. INTRODUCTION

1.1 Objectives

Engeny has been engaged by Knox City Council (Council) to undertake Koolunga Stormwater Quality Study for Koolunga Native Reserve, Ferntree Gully and prepare a summary report.

The objective of this study is to consider a range of Water Sensitive Urban Design (WSUD) options for the site, their suitability, and the measured value / benefits that they can provide.

1.2 Scope

The scope of this project included the following:

(1) Review of background information and documentation.

(2) Site visit to understand local opportunities and constraints (21^{st} Nov 2022).

(3) Optioneering assessment to develop a listing of three WSUD options around Koolunga Native Reserve area.

(4) MUSIC modelling of identified options to assess the water quality outcomes of the preferred scenarios proposed from the optioneering workshop.

(5) Preparation of a report (this report) summarising the findings of the optioneering assessment and MUSIC modelling.

2. BACKGROUND

2.1 Site Overview

Koolunga Native Reserve is located at St Elmo Avenue, approximately 40 km east of Melbourne CBD (refer to Figure 2.1 below for Location /Aerial Plan). Melbourne Water's Forest Road Drain is located within the Reserve and the total catchment area upstream of Blind Creek, the downstream receiving waterway, is shown in purple and Council reserves are indicated in black.

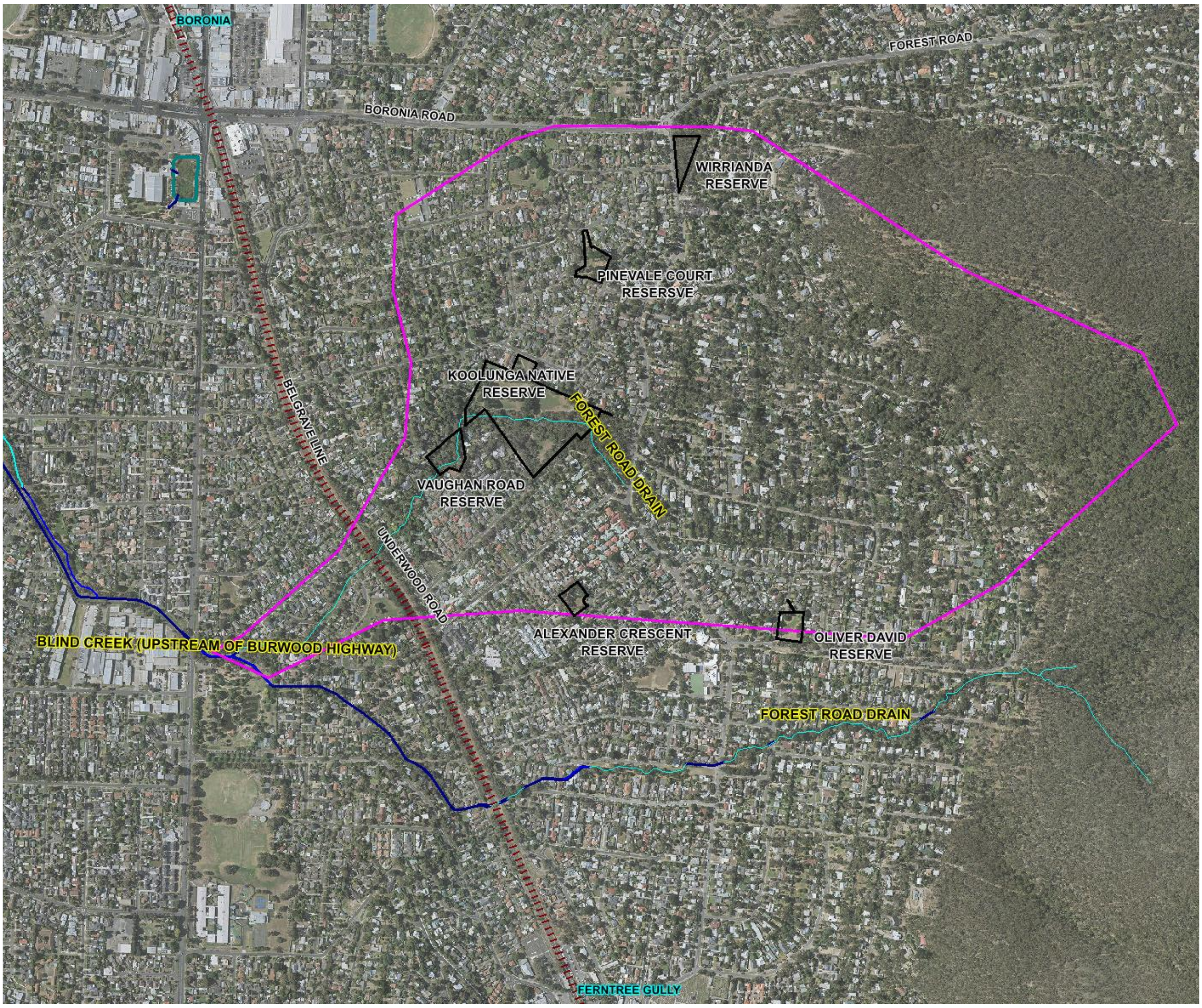


Figure 2.1: Location/Aerial Plan

The reserve is located in the vicinity of the Dandenong Ranges with an overall area of approximately 6 ha. It encompasses some significant biological values and diverse indigenous flora and fauna.

2.2 Koolunga Native Reserve Bushland Management Plan

Dr Graeme Lorimer from Biosphere, a specialist biodiversity consultant, has prepared a Bushland Management Plan for Koolunga Native Reserve and Vaughan Road Reserve report (July 2022) and some of his findings in relation to urban stormwater management aspects are provided below.

"The environmental health of Koolunga Native Reserve and Vaughan Road Reserve is greatly affected by land use and activities in the catchment. The main issues relate to erratic stream flows and altered groundwater depth, followed by water pollution. The erratic stream flows and groundwater changes are cause by the catchment's prevalence of impervious surfaces that divert rainwater into pipes rather than recharging groundwater." Some of the main consequences from these main issues are*:*

- "Stream erosion and consequent deepening of the channel of the Forest Road Drain, causing more loss of native vegetation, lowering of the water table and consequent deaths of eucalypts;
- The Forest Road Drain now goes dry from time to time because of reduced inflows from groundwater, severely affecting aquatic fauna such as fish and invertebrates;
- Each rainfall even results in turbid (cloudy) inflows to the reserves. The turbidity is unhealthy for aquatic life and probably weakly toxic;
- Periodic water pollution events such as the one illustrated by Figure 19 have the potential to kill or adversely affect aquatic fauna and organisms higher on the food chain, in the reserve and downstream. The Friend of Koolunga Native Reserve report at least several such events each year, with variously coloured water.

The concepts of Water Sensitive Urban Design (WSUD) and its variant, 'Sponge Cities', provide options for reducing problem related to erratic stream flows and falling water tables in a landscape like the one of interests here."

Drawing out from Graham Lorimer's findings above, this report provides an optioneering assessment to identify the most feasible WSUD asset(s) and to build key actions that will support Council in making decisions with respect to their potential implementation.

WSUD / stormwater treatment system within Koolunga Native Reserve will provide the following key benefits:

- Reduction of water pollution / improving stormwater quality, which will enhance aquatic life within the Forest Road Drain.
- Improvement of stream health by providing more consistent flows and reduce peak flows into the Forest Road Drain.
- Reduction of stream erosion via erosion prevention works that can be undertaken as part of the stormwater treatment system construction.

3. WSUD OPTIONS

3.1 WSUD Outlet Identifications

Three potential outlet locations where WSUD assets could be implemented within Koolunga Native Reserve have been identified and are outlined as follows and indicatively shown in Figure 3.1:

- **North Outlet –**The existing drainage system that caters for wider catchment area on the northern part of the reserve can be easily diverted to this potential site for stormwater treatment and the outlet from the treatment can be directed to the Forest Road Drain to the south of the open space. This site can be accessed from Daffodil Road and is relatively flat. Photos of the open space area is shown in Figure 3.2. A selection of other photos from the project site visit are provided in Appendix A**.**
- **Southeast Outlet –** This existing outlet falls into the Forest Road Drain and located to the southeast of the reserve. The outlet can be accessed from Old Forest Drain.
- **Southwest Outlet –** This outlet falls into the Forest Road Drain and located to the southwest of the reserve. Access to the outlet is limited, which can only be accessed through the rear of the property at Shirley Court. Alternatively, if this access is not feasible, the proposed WSUD location can be moved further upstream where access can be provided into Koolunga Native Reserve via Daffodil Road.

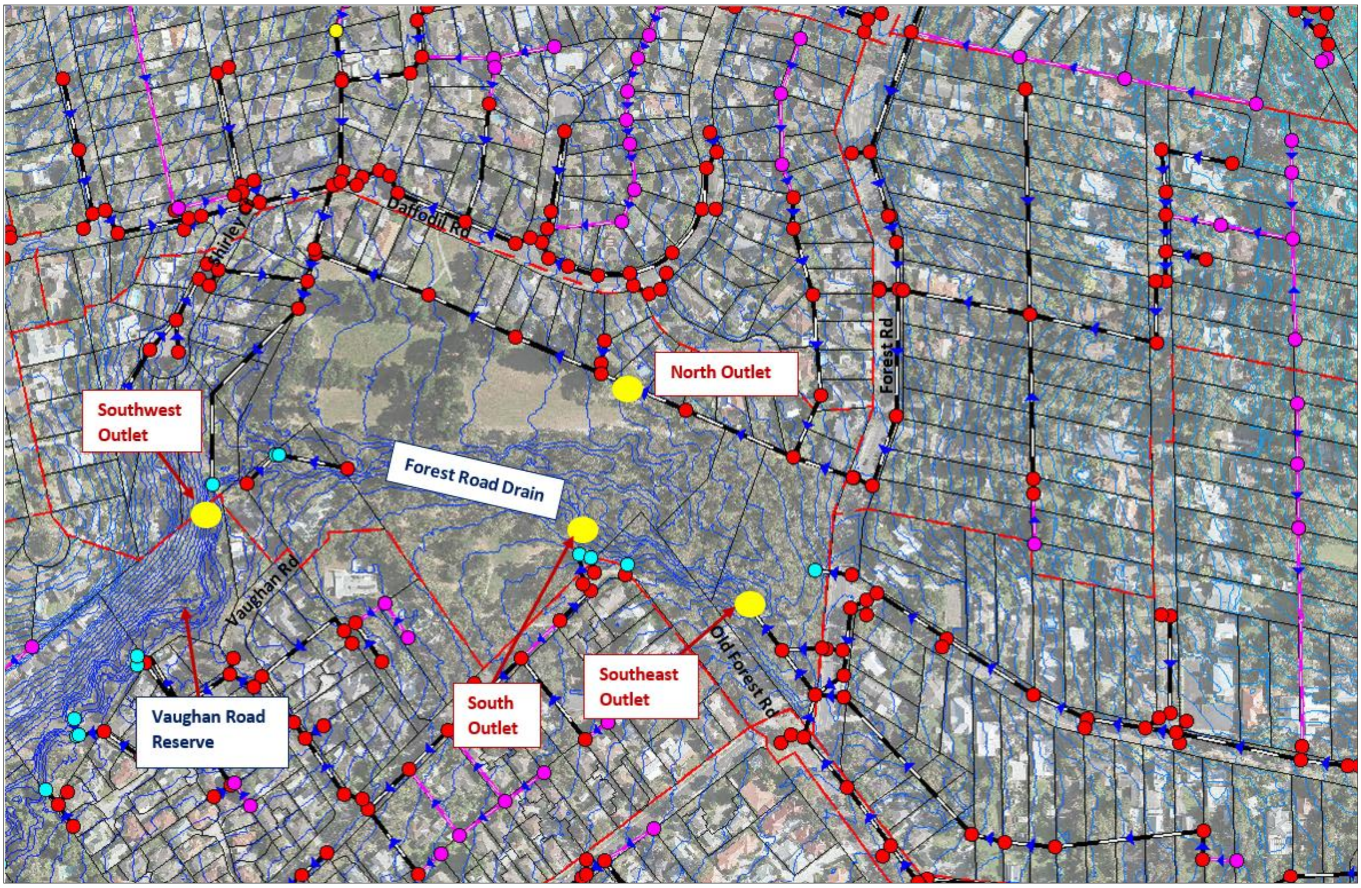


Figure 3.1: Potential WSUD Outlet Locations

The existing south outlet has not been considered due to the catchment draining to this outlet being quite small and predominantly contains the vegetated reserve area (refer to Figure 3.3), hence implementation of WSUD assets will be unlikely to provide any notable stormwater treatment benefits.

Figure 3.2: Open Space Area – Northern Part of the Reserve Facing Northeast

Figure 3.3: Open Space Area – Southern Part of the Reserve Facing South

3.2 Catchment Analysis

Catchment analysis for each potential drainage outlet, as outlined in the previous section, has been determined using GIS data provided by Council and are provided in the following sub-sections.

3.2.1 North Outlet

The total designated catchment area for the north outlet that could be treated via WSUD works in the open space area is 25.5 ha and is shown in Figure 3.4 below.

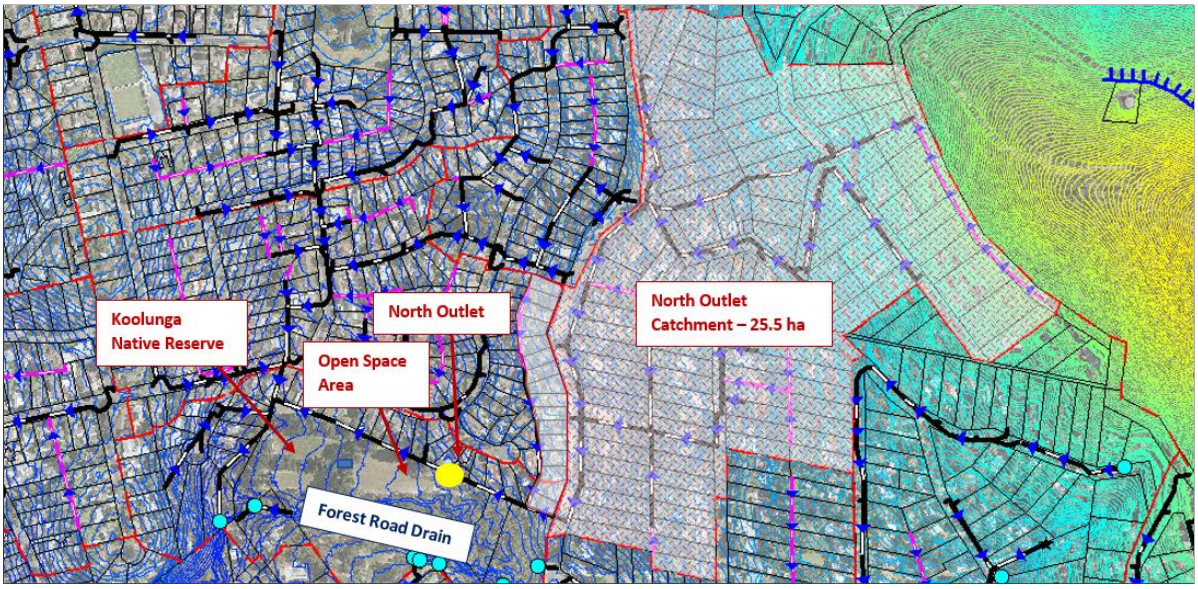


Figure 3.4: North Outlet Designated Catchment Area

3.2.2 Southeast Outlet

The total designated catchment area for the southeast outlet that could be treated via WSUD works is 56.9 ha and ishown in Figure 3.5 below.

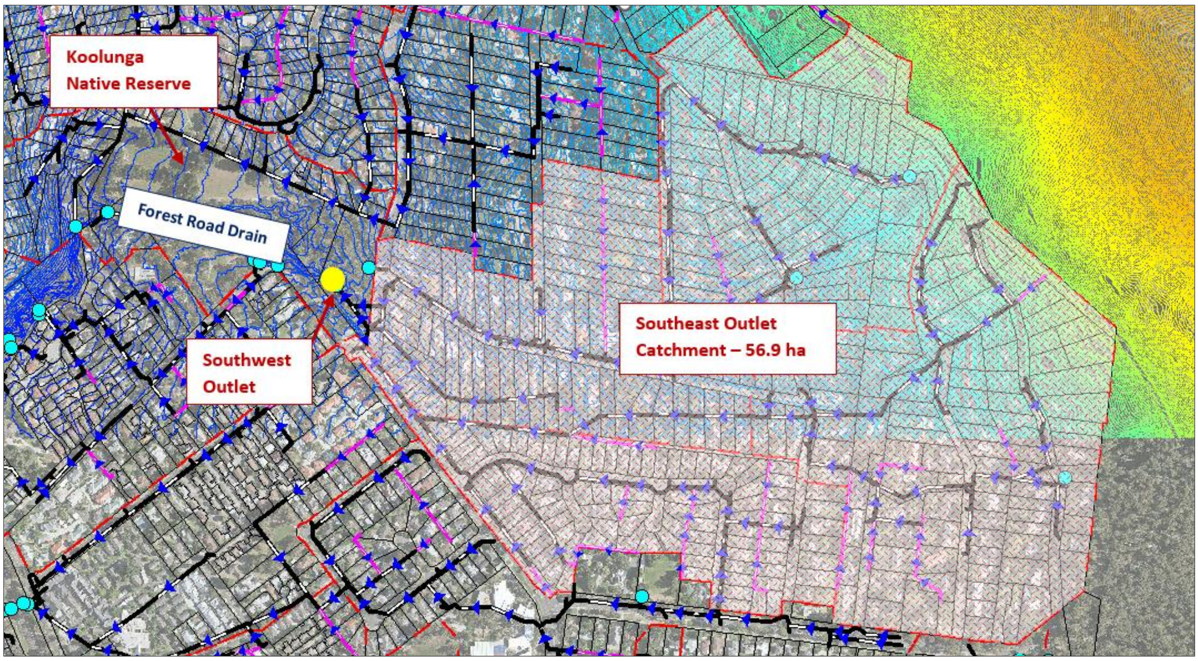


Figure 3.5: Southeast Outlet Designated Catchment Area

3.2.3 Southwest Outlet

The total designated catchment area for the southwest outlet that could be treated via WSUD work(s) is 61.8 ha and shown in Figure 3.6 below.

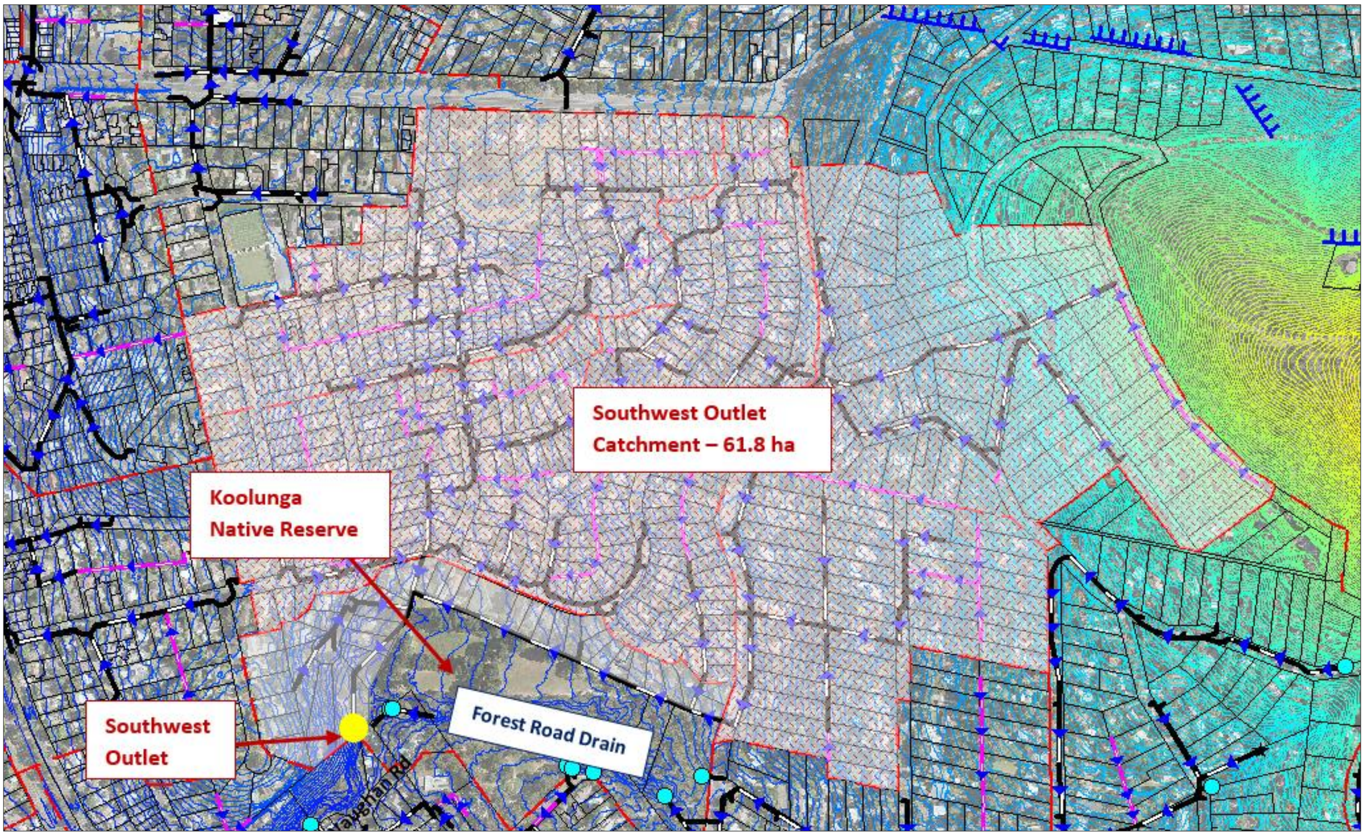


Figure 3.6: **Southwest Outlet Designated Catchment Area**

3.3 Stormwater Treatment Options

Dr Graeme Lorimer's report has provided some options that support the concepts of WSUD. Some of these are outlined below:

- *"Diversion of stormwater from pipes in bio-infiltration wetlands;*
- *Creation of 'rain gardens' or 'vegetated swales' to receive runoff from impervious surfaces and promote infiltration into the ground;*
- *Maintaining or planting vegetation on stream banks to reduce stream erosion during peak flows;*
- *Diversion of stormwater into treatment wetlands, which can double as bio-infiltration wetlands;*
- *Installation of 'gross pollutant traps', 'trash racks' or sediment traps to filter larger and denser solids such as litter and gravel from water in pipes or streams."*

Taking into account the above possible options for WSUD system, a selection process to implement the most optimum stormwater treatment measures as per Melbourne Water guidelines (https://www.melbournewater.com.au/building-and-works/stormwater-management/options-treating-stormwater/selecting-treatment, October 2022) has been adopted and is presented below:

(1) Determine treatment objectives.

- For Koolunga Native Reserve, the objectives are to reduce stormwater pollutant loads as much as practicable.

(2) Understanding the nature of the catchment.

- The subject catchment areas are predominantly existing urban area ranging from low to medium density.

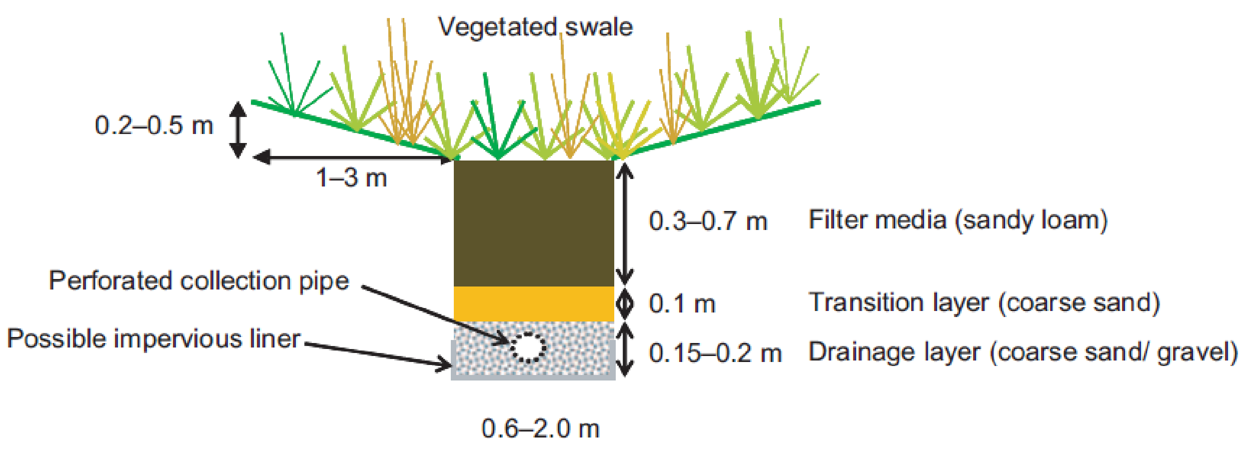
(3) Shortlist of available treatment measures.

- Swale
- A swale is a grassed or vegetated linear stormwater conveyance system to provide gross pollutant, coarse sediments and some nutrient removal. Figure 3.7 below provides an example figure of a vegetated swale system.

Figure 3.7: Vegetated Swale – ***Source: CSIRO (2005)***

- Linear Raingarden

Similar to a swale system this stormwater treatment system includes a filter media that is installed in the base of the asset to infiltrate drainage runoff and provide removal of fine sediment, phosphorous and nitrogen from the stormwater inflow. Figure 3.8 below provides an example figure of a linear raingarden system.



Example Section of Raingarden

Figure 3.8: Example Section of Raingarden – *Source: CSIRO (2005)*

- Gross Pollutant Traps (GPTs)
  - These are devices that are installed underground to provide gross pollutant trap and some sediment removal from stormwater inflow.
- Wetland and sedimentation basin
  - It is understood that a wetland and a sedimentation basin were under consideration, however through the community consultation phase the impact to open space area was considered to be too large. Therefore, this study investigates alternative options that reduce the impact on the open space area whilst still providing water quality benefits.

(4) Determine the optimal treatment measures.

4. WSUD CONCEPT DESIGN AND MODELLING OPTIONS

4.1 Overview of the Koolunga Native Reserve WSUD Design Concepts

Taking into consideration from the availability of the site area, locations of the potential WSUD outlets, Dr Graeme Lorimer's report and Melbourne Water's guidelines, an optioneering assessment with a range of three main options have been undertaken to provide advice for Council to implement possible stormwater treatment measures for Koolunga Native Reserve.

The potential stormwater treatment system measures are proposed to be located at the outlet locations (with some options proposed around the northern open space area) and will provide stormwater treatment for the designated catchment area prior to being discharged into Forest Road Drain, which is a tributary of the larger Blind Creek catchment. The system will also provide controlled stormwater discharge into the tributary and potentially, some landscape features can be incorporated (depending on the treatment type), which will add diversity in flora and fauna and enhance the recreation benefit for the community.

4.2 Stormwater Treatment with Modelling Options Overview

Three main options of MUSIC model runs were undertaken, which are summarised below:

- **Option 1** – This option proposes implementation of GPTs on the potential WSUD outlet locations, as follows:
  - **Option 1a** –two GPTs, one each for Southeast and Southwest outlet catchments.
  - **Option 1b** – one GPT for Southeast outlet catchment only.
  - **Option 1c** – one GPT for Southwest outlet catchment only.
- **Option 2** – This option proposes implementation of a vegetated swale system (located within the open space area) with incorporation of a Gross Pollutant Trap (GPT) to cater for the North Outlet catchment.
- **Option 3** – This option proposes implementation of a linear raingarden system (located within the open space area) with incorporation of a GPT to cater for the North Outlet catchment.

Details of the modelling, parameters, runs and the outputs are provided in the following sections.

4.3 MUSIC Modelling

4.3.1 Parameters

A Model for Urban Stormwater Conceptualisation (MUSIC) model was developed for the subject site. The model was developed in accordance with the most recent Melbourne Water's MUSIC Modelling Guidelines (2018). The following summarises the key parameters adopted:

- 6-minute rainfall data corresponding to the 10-year period between 1984-1993 from the weather station at Narre Warren North (86085).
- Monthly mean evapotranspiration data also included within the Narre Warren's weather template with a mean annual evapotranspiration value of 985 mm.
- Soil Store Capacity = 120 mm and Field Capacity = 50 mm in line with Melbourne Water's MUSIC Guidelines.
- Urban mixed land use source nodes were applied.

4.3.2 Key Inputs

Key inputs to the MUSIC model included:

- The fraction imperviousness adopted are details as per Table 4.1 below.

TABLE 4.1: FRACTION IMPERVIOUSNESS

Catchment Type	Fraction Imperviousness (as per Melbourne Water MUSIC Guidelines 2018)
Residential lots (600-1000m^2)	0.6
Residential lots (>1000m^2)	0.2
Road	0.7

4.4 Option 1 – Gross Pollutant Traps (GPTs)

4.4.1 MUSIC Model Results for Option 1a

This option provides two GPTs with each located at Southwest (SW) outlet and Southeast (SE) outlet (Refer to Figure 4.1 below). Both GPTs will provide stormwater quality treatment for a total designated catchment of 118.7 ha area (56.9 ha for SE outlet and 61.8 ha for SW outlet). The MUSIC modelling schematic for this option is shown in the following Figure 4.2.

The GPTs used in the modelling adopted a treatable flow rate up to 800 L/s. This is an indicative GPT for modelling purpose only and further investigation would be recommended during any subsequent design stages.

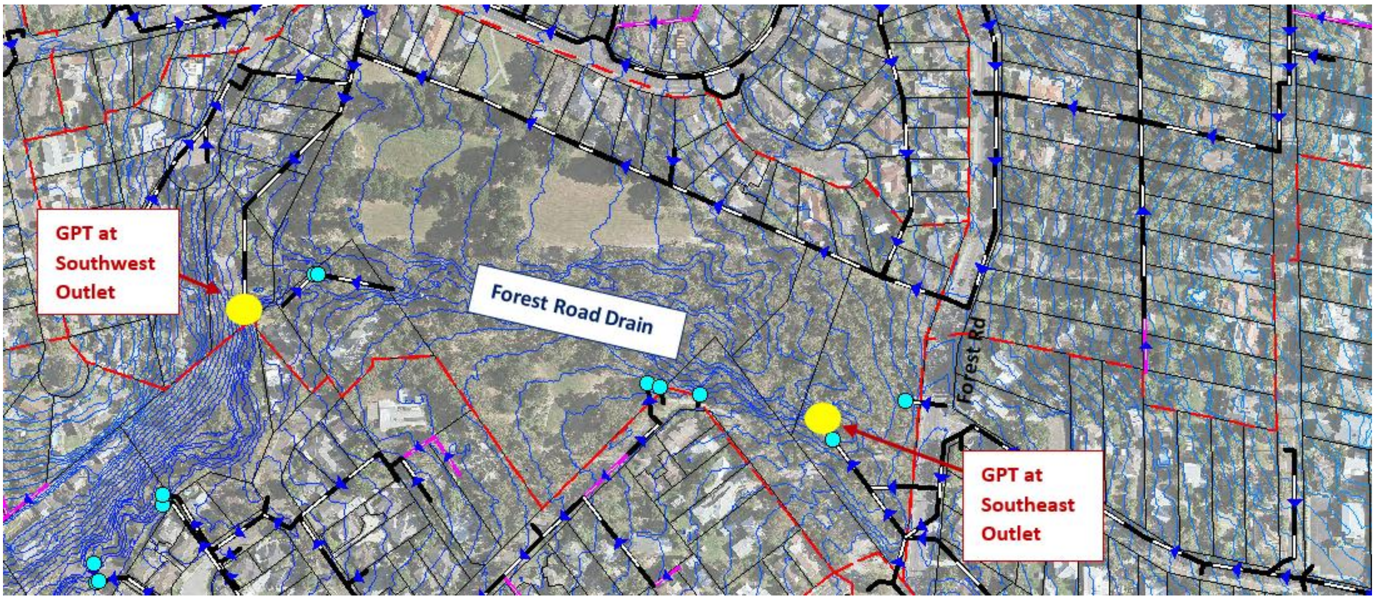


Figure 4.1: Option 1a – Two GPTs at each Southeast Outlet and Southwest Outlet

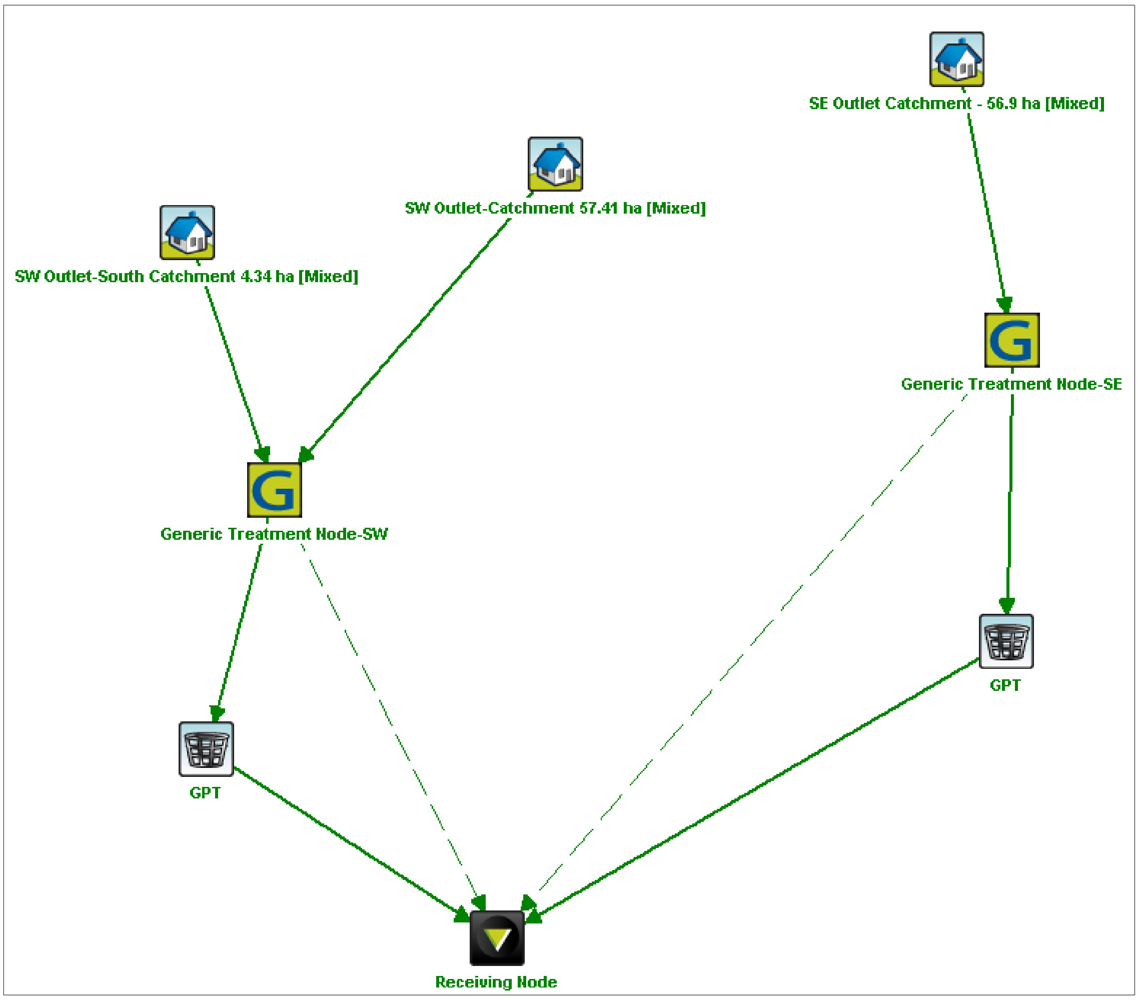


Figure 4.2: MUSIC Modelling Option 1a

The results of the MUSIC modelling are provided in Table 4.2, which includes a comparison to the targets specified in Best Practice Environmental Management Guidelines (BPEMG).

TABLE 4.2: SUMMARY OF STORMWATER QUALITY TREATMENT ACHIEVED FOR OPTION 1A

Parameter	Pollutant Sources	Pollutant Removed	Residual Load	% Reduction	% Reduction as per BPEMG Standard
Total Suspended Solids (TSS) (kg/yr)	103,000.0	66,300.0	36,700.0	**64.4 %**	80.0 %
Total Phosphorus (TP) (kg/yr)	227.0	63.0	164.0	**27.8 %**	45.0 %
Total Nitrogen (TN) (kg/yr)	1,730.0	230.0	1,500.0	**13.1 %**	45.0 %
Gross Pollutants (kg/yr)	22,900.0	21,280.0	1,620	**92.9 %**	70.0 %

As shown above, although only the removal of gross pollutants meets the best practice target, there are reasonable quantities of pollutants removed.

The financial value of nitrogen removal in this sub-option is $1,664,280, based on Melbourne Water typical offset of $7,236 per kg of nitrogen within developer services schemes.

4.4.2 MUSIC Model Results for Option 1b

This option provides a GPT at Southeast outlet only (Refer to the previous Figure 4.1). The GPT will provide stormwater quality treatment for a total designated catchment of 56.9 ha area. The MUSIC modelling schematic for this option is shown in the following Figure 4.3.

The GPT used in the modelling adopted a treatable flow rate up to 800 L/s. This is an indicative GPT for modelling purpose only and further investigation would be recommended during any subsequent design stages.

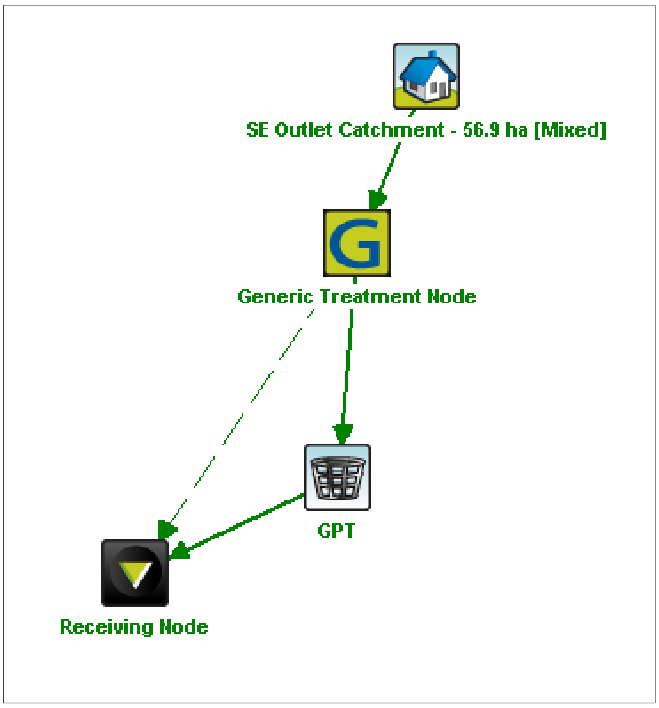


Figure 4.3: MUSIC Modelling Option 1b

The results of the MUSIC modelling are provided in Table 4.3, which includes a comparison to the targets specified in Best Practice Environmental Management Guidelines (BPEMG).

TABLE 4.3: SUMMARY OF STORMWATER QUALITY TREATMENT ACHIEVED FOR OPTION 1B

Parameter	Pollutant Sources	Pollutant Removed	Residual Load	% Reduction	% Reduction as per BPEMG Standard
Total Suspended Solids (TSS) (kg/yr)	48,800.0	31,900.0	16,900.0	**65.5 %**	80.0 %
Total Phosphorus (TP) (kg/yr)	109.0	30.7	78.3	**28.2 %**	45.0 %
Total Nitrogen (TN) (kg/yr)	825.0	110.0	715.0	**13.3 %**	45.0 %
Gross Pollutants (kg/yr)	10,900.0	10,380.0	520.0	**95.2 %**	70.0 %

As shown above and similarly as per Option 1a, although only the removal of gross pollutants meets the best practice target, there are reasonable quantities of pollutants removed.

The financial value of nitrogen removal in this sub-option is $795,960, based on Melbourne Water typical offset of $7,236 per kg of nitrogen within developer services schemes.

4.4.3 MUSIC Model Results for Option 1c

This option provides a GPT at Southwest (SW) outlet only (refer to previous Figure 4.1). The GPT will provide stormwater quality treatment for a total designated catchment of 61.8 ha area. The MUSIC modelling schematic for this option is shown in the following Figure 4.4.

The GPT used in the modelling adopted a treatable flow rate up to 800 L/s. This is an indicative GPT for modelling purpose only and further investigation would be recommended during any subsequent design stages.

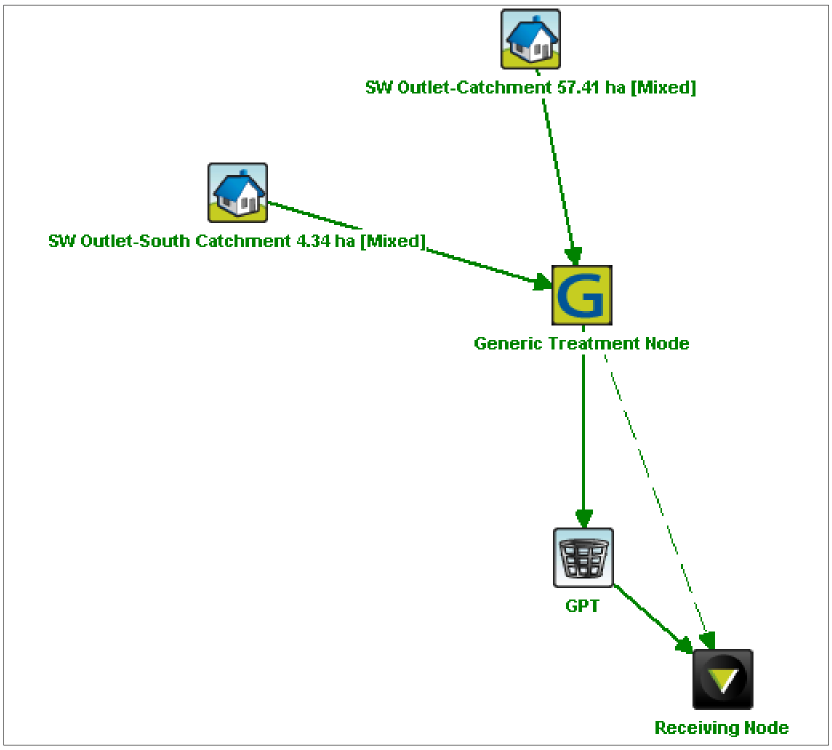


Figure 4.4: **MUSIC Modelling Option 1c**

The results of the MUSIC modelling are provided in Table 4.4, which includes a comparison to the targets specified in Best Practice Environmental Management Guidelines (BPEMG).

TABLE 4.4: SUMMARY OF STORMWATER QUALITY TREATMENT ACHIEVED FOR OPTION 1C

Parameter	Pollutant Sources	Pollutant Removed	Residual Load	% Reduction	% Reduction as per BPEMG Standard
Total Suspended Solids (TSS) (kg/yr)	53,900.0	34,100.0	19,800.0	**63.4 %**	80.0 %
Total Phosphorus (TP) (kg/yr)	120.0	32.8	87.2	**27.3 %**	45.0 %
Total Nitrogen (TN) (kg/yr)	908.0	117.0	791.0	**12.9 %**	45.0 %
Gross Pollutants (kg/yr)	12,000.0	10,900.0	1,100.0	**90.9 %**	70.0 %

As shown above and similarly as per Options 1a and 1b, although only the removal of gross pollutants meets the best practice target, there are reasonable quantities of pollutants removed.

The financial value of nitrogen removal in this sub-option is $846,612, based on Melbourne Water typical offset of $7,236 per kg of nitrogen within developer services schemes.

4.4.4 Maintenance of GPT

As previously mentioned, for GPT maintenance, routine visual inspections and cleaning is required to ensure that the device works properly and no blockages or obstruction to the inlet, outlet and separation screen. During future design stages, should the implementation of a GPT be adopted, the size of the sump storage and low flow / high bypass can be arranged in a manner that is suitable for Council's maintenance team. Consideration is to be given to maintenance access to ensure that access is available for maintenance truck to undertake regular vacuum suction cleaning of the GPT, a dedicated track may be required.

4.5 Option 2 – Vegetated Swale and GPT

4.5.1 MUSIC Model Results

This option includes an approximate 150m length of the vegetated swale (1m base width, 3 m top width and 0.3m treatment depth) along the northern and western boundary of the open space area, as shown by the green line in Figure 4.5 below. Please note that the design depth of the swale can be between 0.5-0.6m to allow for freeboard.

A gross pollutant trap (GPT) is also proposed to be installed on the upstream end of the swale, shown by the yellow circle. The GPT used in the modelling adopted a treatable flow rate up to 360 L/s. This is an indicative GPT for modelling purpose only and further investigation would be recommended during any subsequent design stages.

Both the GPT and the swale will provide stormwater quality treatment for the designated 25.5 ha catchment area to the North outlet. The swale can potentially provide some landscape features that can be incorporated within the open space.

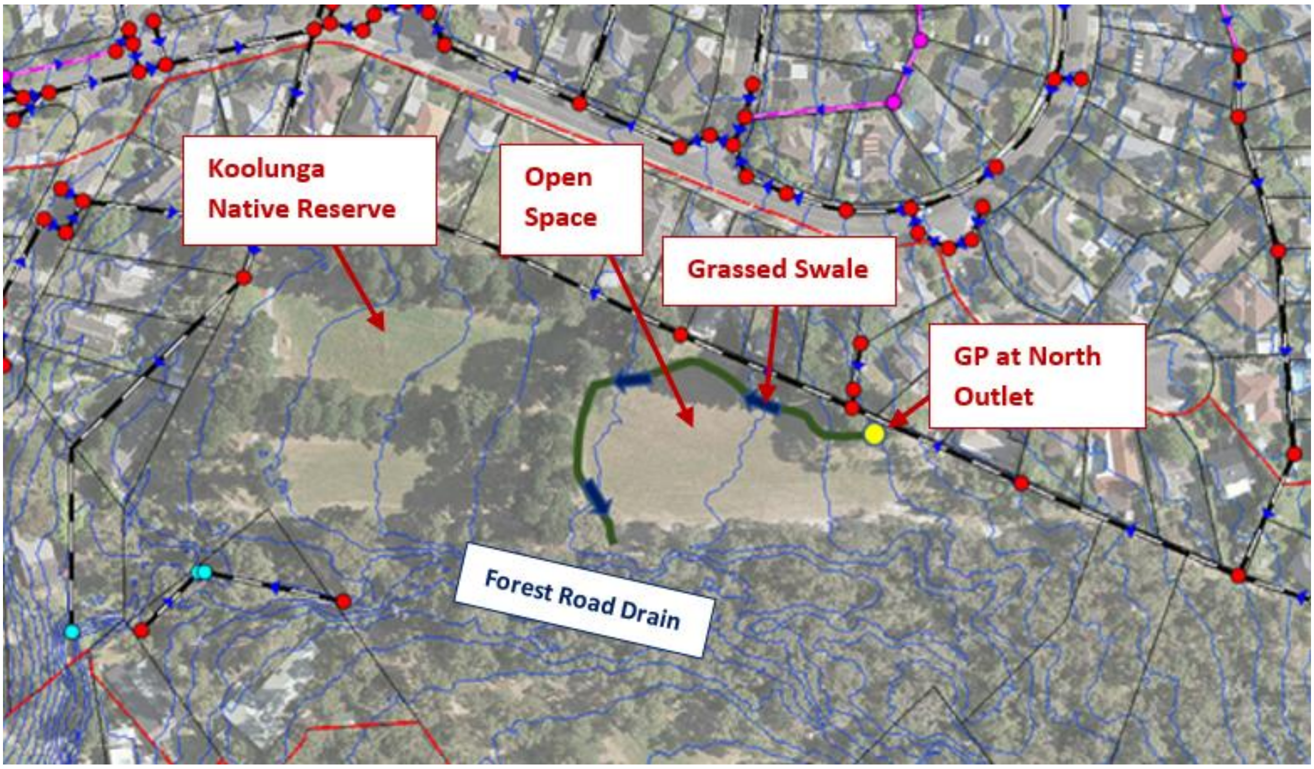


Figure 4.5: Option 2 - Vegetated Swale and GPT

The MUSIC modelling schematic for this option is shown in the following Figure 4.6.

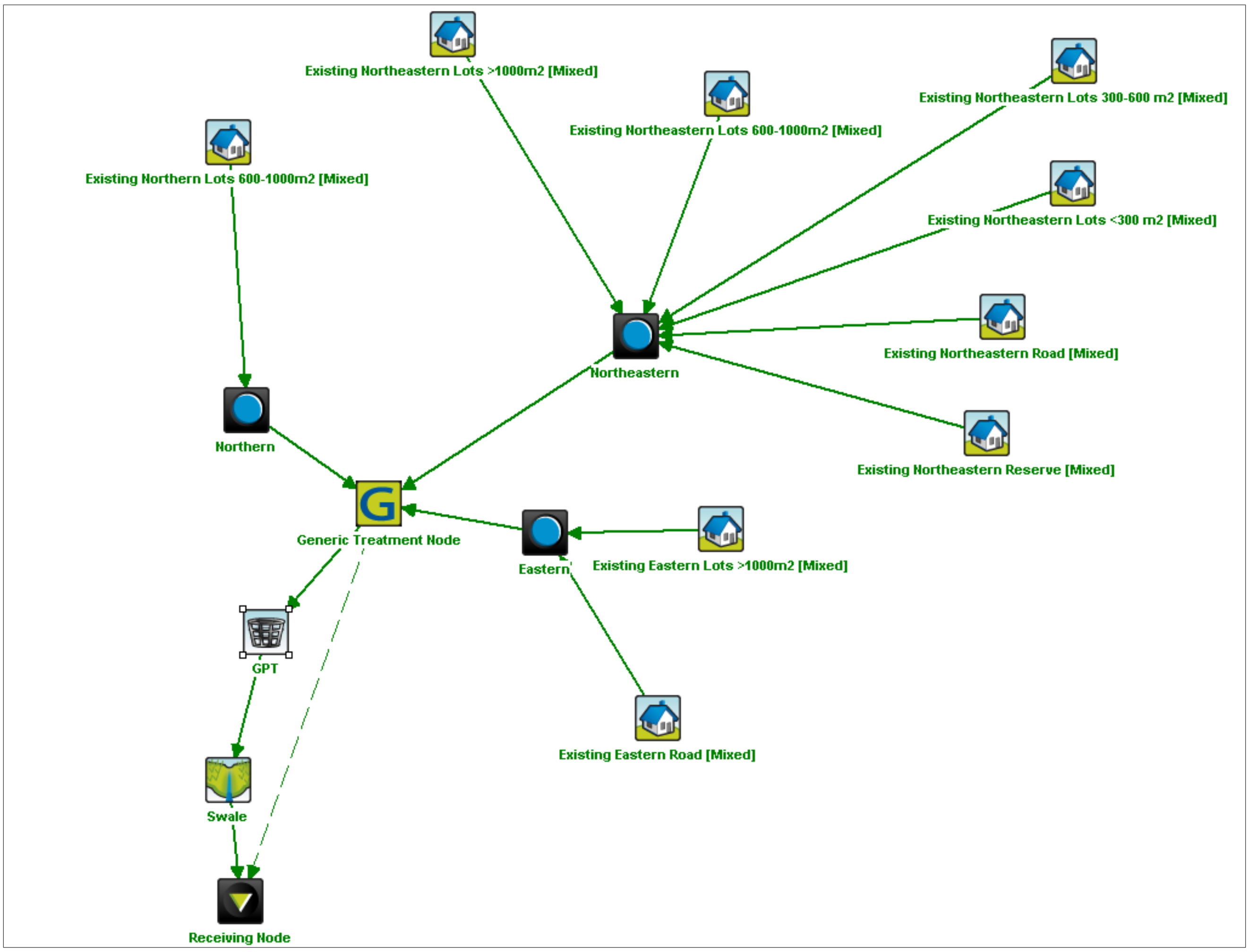


Figure 4.6: **MUSIC Modelling Option 2**

The results of the MUSIC modelling are provided in Table 4.5, which includes a comparison to the targets specified in Best Practice Environmental Management Guidelines (BPEMG).

TABLE 4.5: SUMMARY OF STORMWATER QUALITY TREATMENT ACHIEVED FOR OPTION 2

Parameter	Pollutant Sources	Pollutant Removed	Residual Load	% Reduction	% Reduction Best Practice Standard
Total Suspended Solids (TSS) (kg/yr)	13,000.0	10,350.0	2,650.0	**79.6 %**	80.0 %
Total Phosphorus (TP) (kg/yr)	32.9	16.0	16.9	**48.7 %**	45.0 %
Total Nitrogen (TN) (kg/yr)	276.0	66.0	210.0	**23.7 %**	45.0 %
Gross Pollutants (kg/yr)	2,890.0	2,763.0	127.0	**95.6 %**	70.0 %

As shown above, there are reasonable quantities of pollutants that would be removed, mainly for the TSS, TP and Gross Pollutants which for some of them meet / exceed the Best Practice standard.

Melbourne Water typically charge an offset of $7,236 per kg of nitrogen within developer services schemes, and as such the financial value of nitrogen removal in this sub-option is $477,576.

4.5.2 Maintenance of Vegetated Swale and GPT

The main components of swale maintenance are maintaining the vegetation growth to ensure adequate flow conveyance for treatment, which include the following:

- Vegetation needs to be maintained to facilitate the pollutant removal. i.e., check for weeds and re-establish plants that die (approximately 4-6 weeks).
- Check inlet and outlet for litter, scour and sediment build up and remove periodically (in the order of 4-6 weeks).

According to *Maintaining Water Sensitive Urban Design Elements* report prepared by EPA (April 2008), vegetated swales maintenance cost about \$2.50 - \$3.13/m^2/year. After five years, the cost for vegetated swales decreases to roughly \$0.75 - \$1.5/m^2/year. Based on the required vegetated swale surface area of approximately 450 m^2 from the MUSIC modelling, the estimated maintenance cost will be about \$1,125 - \$1,408 / year and \$337 - \$675 / year after five years.

For GPT maintenance, routine visual inspections and cleaning is required to ensure that the device works properly and no blockages or obstruction to the inlet, outlet and separation screen. During future design stages, should the implementation of a GPT be adopted, the size of the sump storage and low flow / high bypass can be arranged in a manner that is suitable for Council's maintenance team. Consideration is to be given to maintenance access to ensure that access is available for a maintenance truck to undertake regular vacuum suction cleaning of the GPT, a dedicated track may be required.

4.6 Option 3 – Linear Raingardens and GPT

4.6.1 MUSIC Model Results

This option provides an approximate 150m length of linear raingarden (1m base width, 3 m top width and 0.3m treatment depth) along the northern and western boundary of the open space area, with the same alignment as the swale in the previous section, as shown in the green line in Figure 4.7 below. The linear raingarden will have similar shape and length with the vegetated swale and will have approximately 500mm thick filter media installed under the base. Please note that the design depth of the raingarden can be between 0.5-0.6m to allow for freeboard.

A GPT will be also installed on the upstream end of the raingarden, shown in yellow circle. The GPT used in the modelling adopted a treatable flow rate up to 360 L/s. This is an indicative GPT for modelling purpose only and further investigation would be recommended during any subsequent design stages.

Both the GPT and raingarden will provide stormwater quality treatment for the designated 25.5 ha catchment area to the North outlet. The raingarden can potentially provide some landscape features that can be incorporated within the open space.

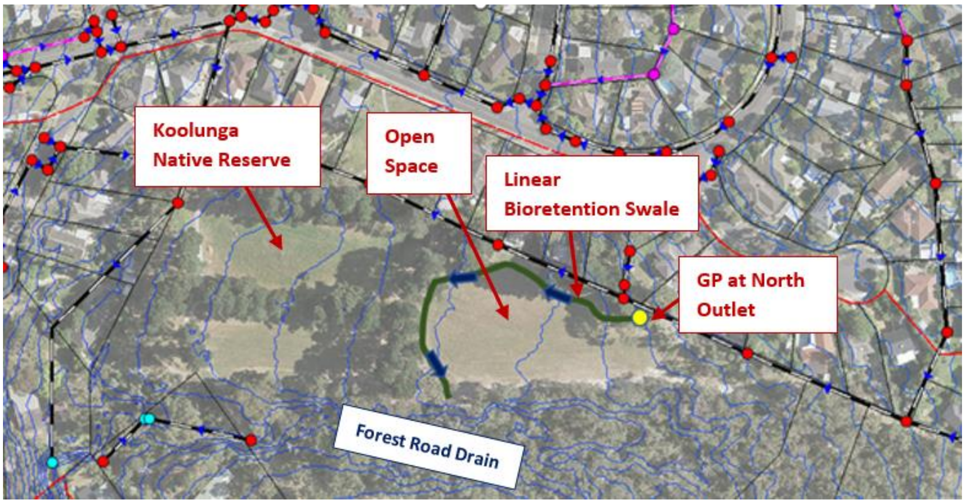


Figure 4.7: Option 3 – Linear Raingraden and GPT

The MUSIC modelling schematic for this option is shown in the following Figure 4.8.

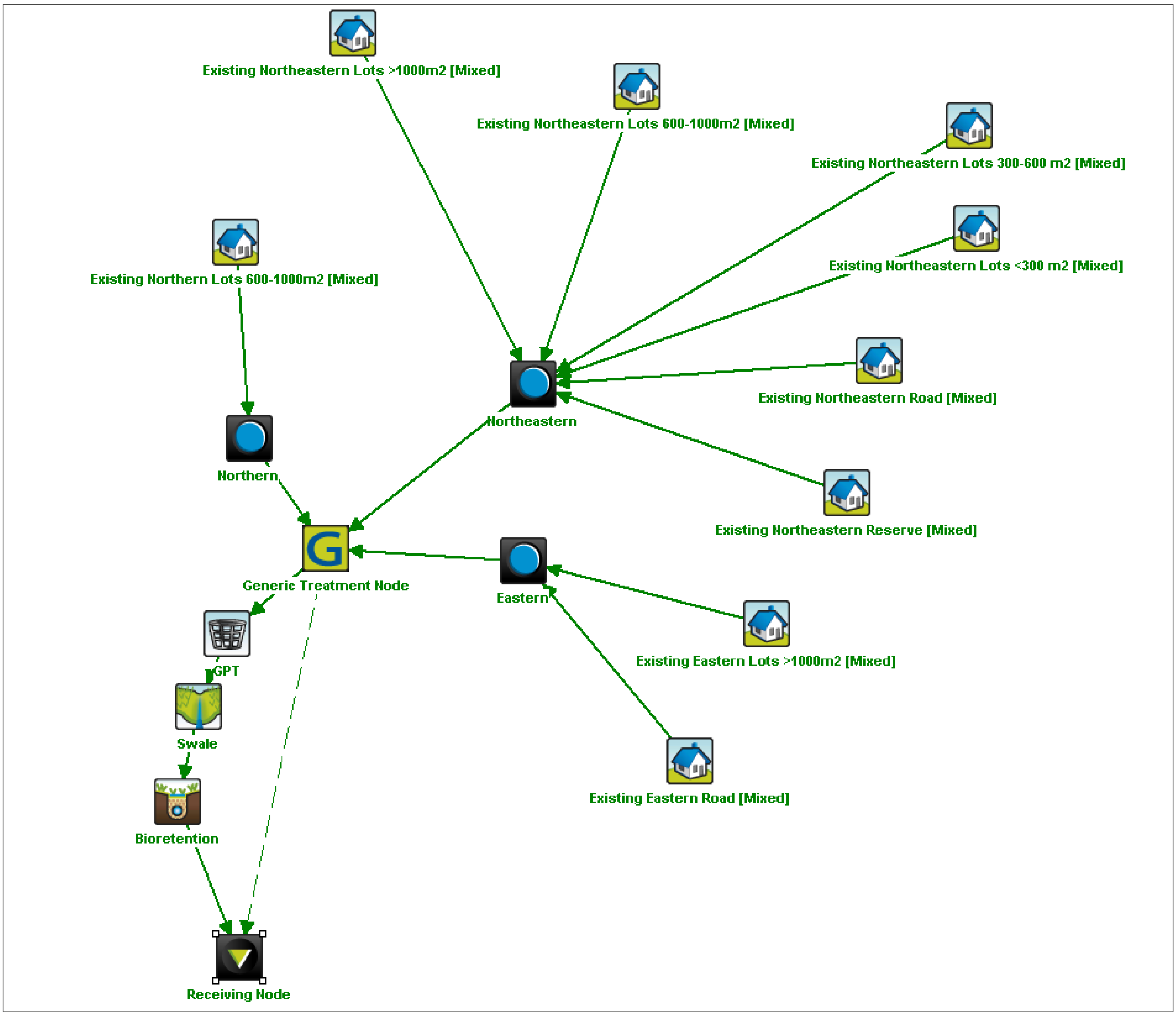


Figure 4.8: **MUSIC Modelling Option 3**

The results of the MUSIC modelling are provided in Table 4.6, which includes a comparison to the targets specified in Best Practice Environmental Management Guidelines (BPEMG).

TABLE 4.6: SUMMARY OF STORMWATER QUALITY TREATMENT ACHIEVED FOR OPTION 3

Parameter	Pollutant Sources	Pollutant Removed	Residual Load	% Reduction	% Reduction Best Practice Standard
Total Suspended Solids (TSS) (kg/yr)	13,000.0	9,950.0	3,050.0	**76.6 %**	80.0 %
Total Phosphorus (TP) (kg/yr)	32.8	16.6	16.2	**49.4 %**	45.0 %
Total Nitrogen (TN) (kg/yr)	276.0	72.6	203.4	**26.3 %**	45.0 %
Gross Pollutants (kg/yr)	2,890.0	2,763.0	127.0	**95.6 %**	70.0 %

Overall, the quantities removed for both option 2 and option 3 are similar. However, option 3 provides a better nitrogen removal due to the added value of raingarden system. The financial value of nitrogen removal in this sub-option is $525,333, based on Melbourne Water typical offset of $7,236 per kg of nitrogen within developer services schemes.

4.6.2 Maintenance of Raingardens and GPT

The main components of raingarden maintenance are maintaining the vegetation/grass growth to ensure adequate flow conveyance for treatment, which include the following:

- Vegetation needs to be maintained to facilitate the pollutant removal, i.e., check for weeds and re-establish plants that die (approximately 4-6 weeks).
- Check inlet and outlet for litter, scour and sediment build up and remove periodically (in the order of 4-6 weeks).
- Check filter media and underdrain, in which it must drain freely, and permeability needs to be maintained. This can be done by infiltration / permeability testing and inspection of pipelines to ensure there is no blockage in both filter media and underdrain. It is recommended that this maintenance (repair as required) to be undertaken approximately every 3-months. As a rule of thumb, filter media will need to be replaced every 5 years. However, this will be largely dependent on the regular 3-month inspection results and replacement of filter media will be required if the system has failed due to blockages or other contributing factors earlier than the 5-year period.

According to Maintaining Water Sensitive Urban Design Elements report prepared by EPA (April 2008), vegetated raingarden maintenance cost about $9/m^2/year, using native vegetation. Based on the approximate 450 m^2 of raingarden area from the MUSIC modelling, the estimated maintenance cost will be about $4,050 / year.

For GPT maintenance, routine visual inspections and cleaning is required to ensure that the device works properly and no blockages or obstruction to the inlet, outlet and separation screen. During future design stages, should the implementation of a GPT be adopted, the size of the sump storage and low flow / high bypass can be arranged in a manner that is suitable for Council's maintenance team. Consideration is to be given to maintenance access to ensure that access is available for maintenance truck to undertake regular vacuum suction cleaning of the GPT, a dedicated track may be required.

5. CONCLUSIONS

Koolunga stormwater quality study has been undertaken to determine the optimum WSUD/stormwater treatment system within Koolunga Native Reserve. The objective of the study was to consider a range of Water Sensitive Urban Design (WSUD) options for the site, their suitability and the measured value / benefits that they can provide.

The assessment includes consideration from Dr Graeme Lorimer's report (July 2022), which highlights the current environment health condition of the reserve and Forest Road Drain has been impacted land use and activities in the catchment (i.e., residential development). This leads to some concerns of the health of the streams (Forest Road Drain and Blind Creek) and aquatic life. The report suggests adopting the concept of WSUD to address those concerns.

Three potential outlet locations to provide WSUD asset/stormwater treatment system within the Koolounga Native Reserve were identified. These include the North outlet, which has a designated catchment area of 25.5 ha and is located adjacent to an open space in the northern part of the reserve that has a direct access from Daffodil Road. The other two potential outlet locations are on the Southeast (SE) outlet, which is located on the southeast of the reserve and has a designated catchment area of 56.9 ha and the Southwest (SW) outlet, which is located on the southwest of the reserve and has a designated catchment area of 61.8 ha.

An optioneering assessment using recommendations from Dr Lorimer's report (July 2022) and Melbourne Water's guidelines for selection process for the most feasible WSUD asset was undertaken. From this assessment and given the availability of space, there were three options considered, which included a vegetated swale, linear raingarden and Gross Pollutant Traps (GPTs) (for the outlet locations).

Engeny has undertaken MUSIC modelling options to assess potential stormwater treatment systems that can be implemented at the three outlets. The main options include Option 1, which proposes GPTs at the outlet locations and has further three sub-options, which includes Option 1a (GPTs at each of the SE and SW outlets), Option 1b (a GPT at SE outlet only) and Option 1c (a GPT at SW outlet only). In addition, Option 2, which proposes a GPT at the outlet location and a vegetated swale along the northern and western boundary of the open space area within Koolunga Native Reserve and Option 3, which proposes a GPT at the outlet location and a linear raingarden at the same location of the swale within the reserve are also have been put forward as part of this optioneering assessment.

Implementation of Option 3 (linear raingarden system and a GPT) will provide the highest pollutants removal with some best practices pollutant removal targets achieved and some potential landscape benefit. However, as an overall, each of the options will provide a considerably high pollutant removal rate and hence, provide value and benefits for the environment and community of Koolunga Native Reserve to mitigate the decreasing environment health of the stream and aquatic life of the Forest Road Drain within the reserve area.

6. QUALIFICATIONS

(a) In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

(b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

(c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

  (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

  (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

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(g) This Report does not provide legal advice.

7. REFERENCES

CSIRO Publishing 2005, WSUD Engineering Procedures – Stormwater

EPA, Publication 1226, April 2008, Maintaining Water Sensitive Urban Design Elements

Knox City Council 2021, Koolunga Native Reserve Wetlands – Community Engagement Summary

Lorimer, Graeme S, PhD 2022, Bushland Management Plan for Koolunga Native Reserve and Vaughan Road Reserve, Ferntree Gully. Version 0.2

APPENDIX A: SITE PHOTOS

Open Space on the Northern Part of Koolunga Native Reserve (Facing Northeast)

Open Space on the Northern Part of Koolunga Native Reserve (Facing East)

Open Space on the Northern Part of Koolunga Native Reserve (Facing East from North-South aligned avenue of Trees)

A section of Open Space within Koolunga Native Reserve

Walking Track at Rear of Daffodil Road Properties looking West

Pedestrain Crossing of Forest Road Drain