South West Loddon Water Supply Project – Detailed Desktop Assessment

For GWMWater

November 2016

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Abbreviations

Abbreviation	Description
CNC	CNC Project Management Pty Ltd
DEWLP	Department of Environment, Water, Land and Planning
DoEE	Department of the Environment and Energy
EES	Environment Effect Statement
EE Act	Environment Effects Act, 1978
EMP	Environment Management Plan
EPBC Act	Environment Protection and Biodiversity Conservation Act, 1999
FFG Act	Flora and Fauna Guarantee Act, 1988
LGA	Local Government Area
MNES	Matter(s) of National Environmental Significance
SWLP	South West Loddon Water Supply Project
WMP	Wimmera Mallee Pipeline

Executive Summary

CNC Project Management (CNC) has been engaged by GWMWater to prepare a detailed desktop assessment of the area within Stage 2 of the South West Loddon Water Supply Project (SWLP) Extent.

The intent of this document is to progress the SWLP planning process by preparing an assessment of areas of environmental significance or sensitivity within the SWLP Project footprint.

Appendix A details the extent of data sources that have been referenced in the preparation of this assessment.

Mapped environmental assets within the Project Extent tend to be heavily concentrated within the following areas:

- Riparian corridors
- Road reserves
- Public land
- Fallow land or uncultivated freehold land (i.e. land not actively used for growing crops)

It is acknowledged that on-ground assessment of a preliminary design corridor is required to confirm this correlation as well as to identify any native vegetation patches or scattered trees that are not contained within the publically available datasets.

In addition to environmental assets, the following environmental threats have been noted as existing within the Project Extent:

- Noxious weeds
- Erosive/dispersive soils
- Saline soils
- Land subject to inundation

These threats must be taken into account in planning methodology so as to identify areas that require further consideration or management measures in order to effectively eliminate or control and manage the intended impacts of construction.

To be able to effectively assess the level of environmental impact that may arise from construction of the SWLP, it is imperative that:

- Environmental assets are identified within the Project Extent
- Environmental threats are identified that directly relate to the proposed disturbance or impact
- The source of each threat is identified for each asset
- The unmitigated impact of each threat is assessed

- Planning commitments are prepared that are designed to control and actively manage each identified risk
- Residual risk is then evaluated where the likelihood of the risk eventuating is considered assuming that the nominated planning commitments have been implemented
- Where risk level cannot be further reduced, the principal of As Low As Reasonably Practicable (ALARP) must be applied.

An Environmental Risk Assessment was undertaken on the 4th October, 2016 (Appendix C).

The planning commitments identified in the Environmental Risk Assessment are consistent with the planning methodology for all GWMWater's pipeline projects, including Stage one design and construction as demonstrated by the Case Study in Section 5 of this assessment.

Stage 2 planning methodology will be reflective of Stage 1 and will form the basis of the SWLP's Environmental Management Framework (EMF). The EMF will be used to guide the Planning process for the Project and form a defined list of planning commitments and activities that will combine to form the basis for design and construction of the SWLP. The EMF will focus on eliminating environmental impacts through the design phase and minimising residual impacts during construction and operation of the SWLP.

1. Introduction

CNC Project Management (CNC) has been engaged by GWMWater to prepare a desktop review and analysis of the key environmental assets and sensitivities within Stage 2 of the extent of the South West Loddon Water Supply Project (SWLP), the proposed extension to the Wimmera Mallee Pipeline.

1.1 Scope

The scope of this desktop assessment is to undertake an interrogation of existing datasets and mapping within the project area to identify location, quantity and value of areas of environmental significance or sensitivity.

Environmental condition will be determined through on-ground assessment and managed through an environmental management framework and construction environmental management plan

1.2 Intent of this Assessment

The intent of this assessment is to identify the extent of areas of environmental significance or sensitivity within the SWLP footprint in order to progress the SWLP planning process.

This desktop assessment is intended to inform the environmental risk assessment process, in order to define a series of planning commitments that will guide on-ground assessment of prospective pipeline alignments so that values can be assessed and quantified and, where possible, avoided during the 'design and assessment' phase of contracted work.

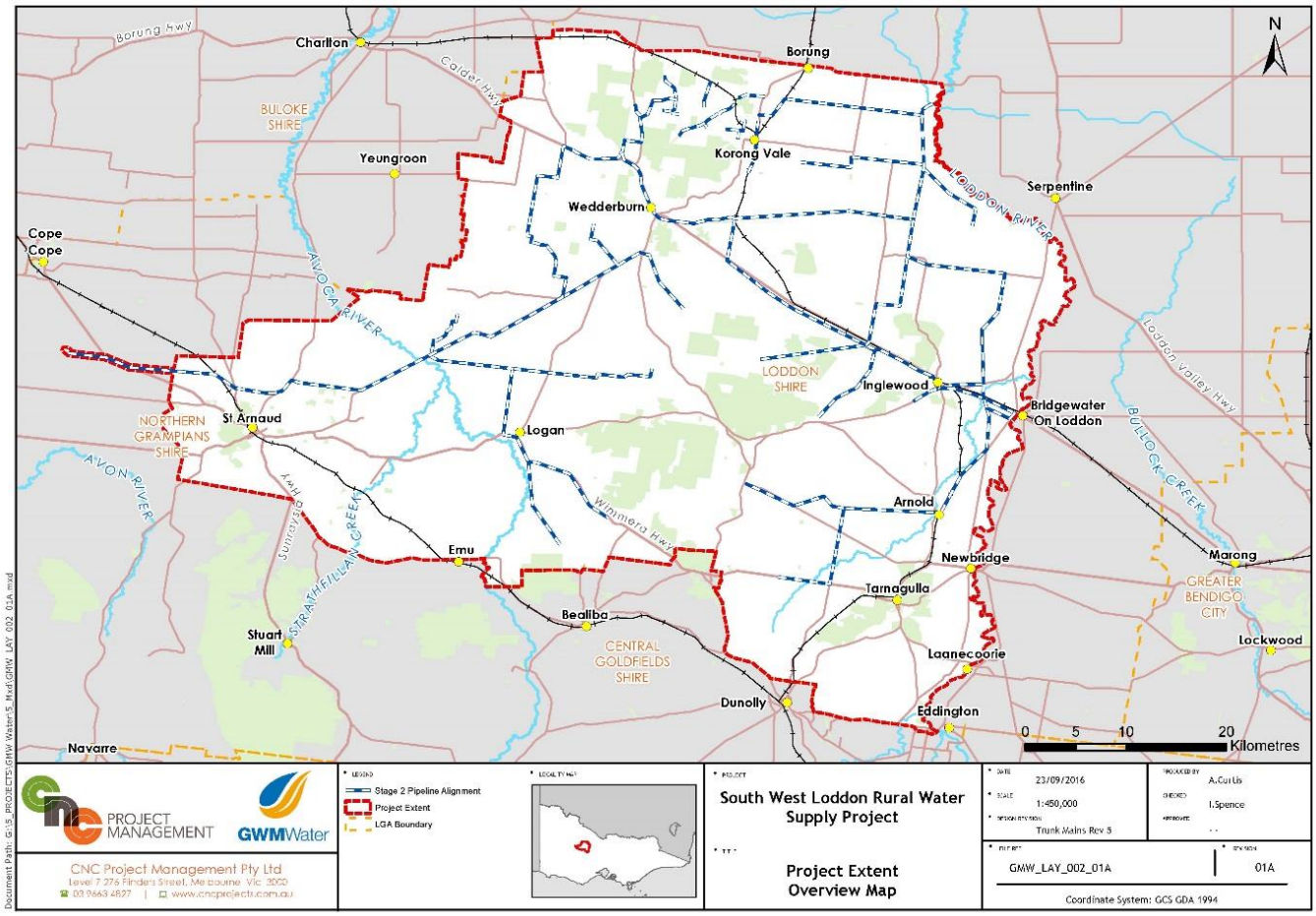
The resulting desktop dataset and planning commitments shall then be used to evaluate the requirement for referral under the Environment Effects Act, 1978 (EE Act) and under the Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act).

The content of this desktop assessment will also be used to inform the preparation of supporting documentation to accompany the request to the Victorian Minister for Planning for a Planning Scheme Amendment under S20(4) of the Planning and Environment Act, 1987.

1.3 SWLP Project Extent

The SWLP Extent ('Project Extent') defines the area within which all potential environmental impact associated with the SWLP can could occur. The project extent (Figure 1) encompasses 289,974Ha in total. The Project is located within the Northern Grampians Shire and Loddon Shire Local Government Areas.

Figure 1: SWLP Project Extent Overview Map



1.4 Project Methodology

GWMWater has a long history of pipeline developments. These include:

- Northern Mallee Pipeline
- Wimmera Mallee Pipeline – over 9,000km
- Five Towns pipeline – 117km
- Landsborough valley – 38km
- Stage One South West Loddon – 110 km
- Pella and Quambatook North – 66km

Over this history of rural pipeline construction, GWMWater has continued to refine its planning and construction methodology to minimise the impact that projects have on the environment to as low as reasonably practicable, with due consideration of the preferences and requirements from regulators and its customers to gain 'best outcomes' for each pipeline.

The methodology adopted for Stage two of the South West Loddon Project is a Design and Construct contract. This involves one company undertaking both the design and construction component of the project.

The contractor will be required to submit a schedule of rates for activities such as:

- Use of grader for pipeline construction – 15 metre impact width
- Ploughing – 8 metre impact width
- Horizontal directional drilling – no surface impact to sensitive areas (assuming that entry/exit points can be located in an area containing low or no values.)

An appropriate technology will be adopted to minimise or avoid significant flora and fauna impacts during the construction of the project. For example, waterways and road crossings that have identified value will be avoided through use of horizontal directional drilling.

GWMWater recognise that approvals and impacts of the project are its risk and are working collaboratively with DELWP to identify the extent of the likely impact in advance of preliminary design.

The intended outcome of this process is to ensure that the design and construct contractor receives all the necessary conditions with which they must comply with, prior to commencement of design. This will lead to a more tailored pipeline design that will be considerate of identified environmental threats and values within the Project Extent.

1.5 Planning Context

GWMWater have confirmed a preference to seek a Ministerial planning scheme amendment under S20(4) of the Planning and Environment Act, 1987 to construct and operate the SWLP. DELWP has indicated that given the project extent and the councils involved, this project could suit a planning scheme amendment.

In order to progress Project planning at this stage it is necessary to prepare an assessment of environmental assets and values so that potential environmental impacts can be evaluated and appropriate commitments can be developed to form the Environmental Management Framework (EMF) of the Project.

The EMF will address how environmental impacts will be managed as low as reasonably practicable throughout the project and allow the Victorian Planning Minister to have sufficient information to make an informed decision as to whether to grant planning scheme amendment under S20(4) of the Planning and Environment Act, 1987.

The EMF will also serve to inform the tendering design and construction contractors of the environmental commitments that they must consider when preparing their tender responses.

The SWLP Project execution can be broken down into three phases:

1. Planning Phase;

2. Design and Assessment Phase; and
3. Construction Phase.

1.5.1 Planning Phase

GWMWater is taking a qualitative approach to project planning which involves the following steps:

- Definition of the Project Extent and notional pipeline alignment;
- Desktop assessment of environmental values using available State Government data layers;
- Environmental risk assessment of proposed impacts against the identified environmental values;
- Self-assessment (EE Act and EPBC Act);
- Referral under the EE Act
- Development of an EMF containing commitments to avoid, minimise and mitigate impacts with a framework for offsetting residual impact (or otherwise as required by the Minister for Planning and/or the Minister for Environment;
- Preparation of remaining documentation to support Planning Scheme Amendment request to the Minister.

GWMWater see value in advancing the planning process in the absence of detailed design or on-ground environmental assessment of the proposed SWLP with the intent of preparing an environmental planning framework.

This will include endorsement of the basis for review and acceptance of the on-ground assessment of impacts and proposed mitigation measures during the subsequent 'Design and Assessment' phase of the Project.

1.5.2 Design and Assessment Phase

GWMWater will engage a contractor to undertake the following activities during the 'Design and Assessment' phase of the Project:

- Preliminary design of the SWLP piped system;
- On-ground assessment of preliminary design corridor (Ecological, Cultural, Social);
- Application of the Project planning framework commitments to avoid and minimise environmental impacts;
- Revision of feedback into detailed design and incorporation of changes to avoid and minimise impact; and
- Preparation of Project Construction Environmental Management Plan (CEMP) and associated sub-plans (including threatened species management, native vegetation management, offset management plan, etc), permits and other associated regulatory requirements, based on the detailed design.
- Obtain approvals (and offsets) prior to commencement of construction.

It is possible that this phase may be broken down into several sub-phases so as to facilitate construction commencement. This will be the responsibility of the successful contractor (noting that offsets will still be the ultimate responsibility of GWMWater).

It is GWMWater's role to ensure that any proposed 'staging' of the planning work will deliver practical time-savings and be considerate of DELWP's resources to complete review and approval of environmental assessments for discrete areas of the SWLP.

The number of stages that the SWLP will be broken into will be determined in consultation with DELWP.

1.5.3 Construction Phase

The 'Construction' phase of the contracted work will involve:

- Implementation of the Construction Environmental Management Plan during mobilisation, construction and reinstatement of the SWLP;
- Internal monitoring, auditing and reporting to demonstrate Project compliance with all environmental, cultural and social approvals conditions. The construction contractor will be responsible for demonstrating continued compliance with GWMWater having responsibility to ensure that specified conditions and commitments are being met.
- External (third party) auditing to ensure Project compliance with all environmental, cultural and social approval conditions.

It is proposed that all construction activities shall be subject to approval of a Construction Environmental Management Plan that will be prepared during detailed design by the construction contractor. The CEMP will contain site specific values, impacts and mitigation measures that reflect the detailed design of the SWLP.

2. Establishment of Environmental Threats

The purpose of this desktop assessment is to identify, locate and quantify 'environmental assets' to gain an understanding of the type of values that exist within the Project Extent.

2.1 Introduction

To be able to effectively assess the level of environmental impact that may arise from construction of the SWLP, it is imperative that:

- Environmental assets are identified within the Project Extent
- Environmental threats are identified that directly relate to the proposed disturbance or impact
- The source of each threat is identified for each asset
- The unmitigated impact of each threat is assessed
- Planning commitments are prepared that are designed to eliminate, or control and actively manage each identified risk
- Residual risk is then evaluated where the likelihood of the risk eventuating is considered assuming that the nominated planning commitments have been implemented
- Where risk level cannot be further reduced, the principal of As Low As Reasonably Practicable (ALARP) must be applied.

2.2 Definition of an Environmental Threat

An environmental threat is an activity that has the potential to detrimentally impact the receiving environment. Such an activity may be direct, where there is an immediate cause/effect with the level of impact at a local scale, or indirect, where the activity causes follow-on effects, or triggers a series of subsequent events, which in turn may result in environmental impact ('facilitated impacts').

2.3 Proposed Infrastructure

The following infrastructure is proposed to be constructed and operated within the Project Extent:

GWMWater SWLP Activities

- Construction of up to 360km of trunklines (require up to 15m wide right of way – the intended width of the construction disturbance footprint)
- Construction of up to 1,000km of distribution lines (require up to 15m wide right of way)
- Construction of up to twelve pump stations/ booster pump stations and storage tanks. Detail of number and location will be confirmed during the detailed design phase of the Project.

- Installation of an offtake at the Waranga West Channel
- Installation and operation of air valves and scour valves (above ground infrastructure) - locations to be determined during detailed design phase
- Power line extensions to the proposed pump station sites and booster sites (locations to be determined during detailed design phase)
- Up to 670 water meter installations at water supply points (approximately)
- Ancillary impacts (locations to be determined during detailed design phase) including:
    - Laydown/ Storage areas for pipe, machinery and equipment
    - Access points/ temporary access
    - Vehicular turnarounds
- Installation of pipeline marker signs to provide a visual above-ground indication of buried infrastructure.

Facilitated Impact

- On-farm installation of 20mm polyethylene pipeline by private landowners, in order to deliver water from their connection (metering) points at property boundaries to strategic delivery points (tank installations).
- Installation of firefighting standpipes and/or tanks (on smaller diameter pipelines) that will be located at strategic points throughout the system for use and access by emergency services personnel during an emergency event.

GWMWater Operational Impacts

- Ad hoc maintenance and repair of the system
- Energy to operate the system

2.3.1 Proposed Impacts

In the absence of detailed design and for the purpose of this assessment, maximum possible disturbance (without mitigation) has been calculated in order to provide a 'worst case' area of ground disturbance associated with the proposed construction work.

Table 1: Proposed Ground Disturbance

Construction Element	Maximum Construction Length (m)	Maximum Construction Width (m)	Maximum Number	Total Ground Disturbance Area (Ha)
Trunk lines	360,000	15	1	540
Distribution lines	1,000,000	15	1	1,500
Skinners flat balancing storage	50	50	1	0.25
Offtake at Waranga West Channel	50	35	1	0.175

Construction Element	Maximum Construction Length (m)	Maximum Construction Width (m)	Maximum Number	Total Ground Disturbance Area (Ha)
Pump stations and storages (incl. booster pump stations	50	35	12	2.1
Laydown/storage* (estimate 1 per 50km)	200	185	27.2	100
Access points/ temporary access* (estimate 1 per 800m)	10	10	1,700	17
Installation of air valves* (from pipeline to fence line)	10	3	1,700	5.1
Vehicular turnarounds* (estimate 1 per 2km)	40	35	680	95.2
Water meter installation*	10	3	660	1.98
Power line installation to pump stations*	250	10	12	3
Total Maximum Project Ground Disturbance Area				**2,265.45**
Total % Ground Disturbance Area within Project Extent (289,794Ha)				**0.78%**

**estimated maximum value.*

It has been demonstrated repeatedly on previous piped water projects that with firm planning commitments in place environmental and cultural impacts can be minimised through informed infrastructure siting in areas of farmland or similar land use with few environmental or cultural values, following on-ground assessment of the initial detailed design.

2.3.2 Project Execution

Table 2 (below) outlines the high level Project execution milestones and planning milestones and their estimated timing.

Table 2: Project Planning and Execution Pathway (indicative only - assumes that no EES will be required and the project will not be considered a 'controlled action')

Timing	Project Execution Milestones	Planning Milestones (GWMWater)
Q3 2016	• Preparation of Project execution strategy • Preparation of contract • Preparation of EOI for tendering parties • Tender package commencement	• Establish fortnightly forum with DELWP to pro-actively discuss planning approach • Identify Project extent • Determine preferred Project planning pathway
Q4 2016	• EOI process to select tendering parties •	• Preparation of EE Act self-assessment • Preparation of EPBC Act self-assessment • Preparation of Environmental Management Framework • Preparation of Planning Scheme Amendment supporting documentation • Prepare and agree upon the process for review and approval of critical Project documentation • Determine frequency of auditing, monitoring and reporting during active construction phase with DELWP
Q1 2017	• EOI selection process complete • Tender package finalised • Tender package released to tendering parties • Close of tender • Tender evaluation and award • Commencement of 'Design and Assess' phase of contracted works • Confirmation of the number of 'construction stages' that the Project will be broken into	• Preparation of EE Act referral • Minister's response to EE Act referral • Preparation and Submission of request for Planning Scheme Amendment to DELWP for review prior to presentation to the Minister. • Review of Planning Scheme Amendment Request by the Minister • Continue regular Project progress updates with DELWP
Q2 2017	• Preparation of preliminary design corridor, broken down by construction stages. • Assessment of preliminary design corridor, in line with construction stages. • Generation of assessment reporting and incorporation of recommendations into detailed design	• Receive response from the Minister re: Planning Scheme Amendment Request. o GWMWater expect a conditional incorporated document that will provide acceptance for the

Timing	Project Execution Milestones	Planning Milestones (GWMWater)
	• Commencement of Construction Environmental Management Plan (CEMP) preparation based on detailed design	construction of the SWLP subject to preparation of several further documents for approval/endorsement. • Continue regular Project progress updates with DELWP
Q3 2017	• Finalisation of detailed design • Finalisation of CEMP • Submission of CEMP to DELWP for approval/endorsement • Draft pre-construction commitment documentation	• Submit the CEMP for approval/ endorsement • Submission of EPBC referral • Negotiate and obtain native vegetation offset obligations • Continue regular Project progress updates with DELWP
Q4 2017	• Finalisation of pre-construction commitments for approval • Obtain 3rd party approvals and permits • Commencement of 'Construction' phase of contracted works	• Submission of pre-construction commitment documentation to DELWP for approval (as per incorporated document) • Continue regular Project progress updates with DELWP
Q1 2018	• Construction of contracted works • Monitoring, compliance and reporting on construction performance in relation to approval conditions and CEMP	• Provide oversight of construction. • Facilitate monitoring, auditing and reporting of Project compliance and progress during construction • Continue regular Project progress updates with DELWP
Q2 2018	• Construction of contracted works • Monitoring, compliance and reporting on construction performance in relation to approval conditions and CEMP	• Provide oversight of construction. • Facilitate monitoring, auditing and reporting of Project compliance and progress during construction • Undertake post-construction inspection at regular intervals to identify any defects • Continue regular Project progress updates with DELWP
Q3 2018	• Completion of contracted works • Monitoring, compliance and reporting on construction performance in relation to approval conditions and CEMP • Closeout of CEMP commitments	• Provide oversight of construction. • Facilitate monitoring, auditing and reporting of Project compliance and progress during construction • Undertake post-construction inspection at regular intervals to identify any defects

Timing	Project Execution Milestones	Planning Milestones (GWMWater)
		• Continue regular Project progress updates with DELWP • Compile 'Lessons Learnt' from Project planning and delivery.
Q4 2018 – Q4 2020	• Defects Liability Period – repair or address any defects with the piped water supply system • Operate and maintain the asset – work on gaining optimisation within the system.	• Project funding acquittal

2.4 Proposed Construction Activities

Construction will consist of a series of temporary ground disturbance activities. For larger diameter pipeline (including trunklines), the process will generally consist of the following:

Ground Preparation

- Pre-construction walk through – Project personnel will perform a 'walk through' whereby they locate and mark off identified areas of sensitivity. They also mark trees for removal, for trimming or for protection, including tree protection zone barriers if/where required.
- Tree trimming and removal – specialist crews undertake lopping, trimming or removal of appropriately marked trees and other vegetation in accordance with environmental conditions.
- Fence cutting – fences will be opened up and temporary access will be installed.
- Weed hygiene areas – where identified, machinery hygiene stations will be set up to assist in management of regional and noxious weeds.
- Laydown and storage – areas for laydown of pipe and associated materials and equipment will be cleared by removing the topsoil and installing temporary protective materials (i.e. crushed rock) as required. Vegetation protection barriers installed as required.
- Installation of temporary access tracks to site as required
- Service location – underground services will be located using air compressors and identified using markers or stakes.

Pipeline Installation

- Clear and grade – ground is prepared by grading or otherwise removing the topsoil to the extent of the working area or 'Right of Way (RoW)'. This is performed in order to preserve the topsoil and the seed bank contained within it, in order to facilitate successful rehabilitation following reinstatement
- Pipe stringing – Pipe is 'strung out' or laid out along the RoW end to end sitting on wooden stakes or bags of sawdust in preparation for joining. Regular breaks are made to allow for maintenance of access (for landholder or for stock as previously agreed) and also to allow for emergency services to get through should they require to.
- Trenching – a dedicated trenching machine (bucket wheel trencher) or excavator will dig the trench to the required depth. Excess from the trench or 'spoil' is heaped to the other side of the trench as that of the pipe strings. Spoil and topsoil are kept separate.
- Pipe laying– Bedding sand may be required to protect the pipe. A truck with a modified trailer drives ahead of the pipe laying crew and dispenses a layer of sand into the trench.

  (PVC pipe) - Pipe is lifted from the string into the trench using a 'sling' and an excavator. The pipe is joined together using an industrial glue and manually fed through an 'O-ring' and joined.

(PE pipe) – The PE pipe is fuse welded together using specialised equipment and then lowered into the trench once it has cooled using a succession of excavators and slings.

- Installation of valves – Above ground air valves and scour valves will be installed at regular intervals throughout the piped areas. These will typically be contained inside of a cement casing to protect them. These are required to ensure efficient/sustainable operation of the pipeline system.

  In hilly sections or areas such as creek crossings where the trench runs on a gradient, 'trench breakers' will be installed that have been designed to stop erosion caused by water running down and beneath the pipe following construction.

- Backfill and compaction – the trench spoil is picked up, sifted to remove any sharp stones or objects and re-laid into the trench around the pipe using a special piece of equipment. The spoil is then compacted using another modified piece of equipment to ensure that there will be minimal settlement following construction.

- Hydrotest – sections of installed pipe must be pressure tested to ensure that they are capable of operating at or above operational water pressures. Sections of pipe are progressively filled with water and tested with any non-compliant sections dug up and repaired.

- Reinstatement – Topsoil is brought back across the RoW progressively following backfill and compaction. Some sections require to be left due to final parts being installed around valves, etc.

  Appropriate erosion and sediment controls are installed to protect the RoW from subsequent rainfall events. The land is then either re-seeded or re-worked by the landholder as per their request.

For trunk and distribution pipelines, 'plough-in' methodology can be used which involves a specialised 'plough' unit deep ripping lengths of PE pipeline directly into the ground.

Lengths of PE require to be 'fuse welded', either by welding lengths together on the right of way prior to installation or by fuse welding 'in situ' where a bell hole is excavated every 500-800m to weld the two lengths of pipeline together. Once the pipeline has been reburied, the area of disturbance is rolled flat with a few passes of a heavy plant wheel. This is a quicker form of construction than traditional trenching and involves a narrower corridor of ground disturbance, but is not always possible to adopt this method, depending on soil characteristics.

Horizontal Directional Drilling (HDD) or similar is regularly used to avoid surface impact at sensitive sites or technically difficult crossings of roads/watercourses/ railway lines.

The HDD process involves the establishment of a drill pad area and the drilling of a 'pilot hole' from the drill pad to receiver point. Pipeline is strung out and attached to the drill at the receiver point and installed by being pulled back through the pilot hole by the drill head.

2.5 Facilitated Impacts

GWMWater has identified two facilitated impacts that will be associated with the SWLP construction work.

2.5.1 On Farm Works

Private landholders who formalise an interest in connection will be responsible for all on-farm works associated with connecting designated water meter point(s) (supplied by GWMWater as part of the SWLP) to strategic points around the property to optimise water use and delivery. This will involve laying 20mm poly pipe from a tapping point outside their property to a storage tank catering for three days, peak supply.

The Project identifies that environmental savings will be achieved through the substitution of on farm dams water for the use of piped water. The Project does not include any commitment to decommission on farm storages.

2.5.2 Firefighting Access Points

The Country Fire Authority is likely to register an interest in accessing the SWLP for firefighting purposes. Standpipes and/or tanks (on smaller diameter pipelines) are likely to be located at strategic points on crown land or road reserves throughout the system for use and access by emergency services personnel during an emergency event.

2.6 Proposed Operational Activities

The following operational activities are proposed within the Project Extent:

- Electricity use to operate the pressurised system
- Monitoring of water meters installed at connection points, although all meters will have remote monitoring devices attached to them to avoid regular on-site monitoring.
- Ad-hoc maintenance and repair work where there is a fault or infrastructure otherwise requires replacement
- Ad-hoc installation of additional water supply points, driven by landholder request

Any proposed repair or replacement will be undertaken in accordance with the operational management plan which will include environmental protection procedures in order to safeguard areas of environmental value and sensitivity during the operational phase.

Maintenance and repair work is likely to be sporadic and low impact, being undertaken in isolated locations where operational issues are identified using remote based monitoring equipment.

3. Establishment of Environmental Assets

In order to determine what level of potential environmental impact the proposed construction and operation activities of the Project (the 'threats') will have, it is necessary to identify what environmental assets currently exist within the Project Extent and where they are located.

3.1 Definition of Environmental Asset

Environmental assets may be described as:

Naturally occurring entities that provide environmental "functions" or services. These include those entities which have no economic values, but bring indirect uses, benefits, options and bequest benefits or simply existence benefits which cannot be translated into a present day monetary value.

Edited from: https://stats.oecd.org/glossary/detail.asp?ID=6421

3.2 Criteria for Assessment

The scope of this desktop assessment is to identify location, quantity and value of areas of environmental significance or sensitivity within the Project extent.

The location and quality of data can be obtained from a standard review of publically available datasets of environmental assets.

Whilst the value/significance of environmental assets is more subjective and open to interpretation, for the purpose of this assessment, value has been determined in a way that is consistent with referral criteria under the EE Act (1978) and the EPBC Act (1999).

It is recognised that this desktop review is an indicative reflection of values within the Project Extent and that detailed on-ground assessment of pipeline disturbance corridors will be required to confirm the presence or absence of these values (and any previously unidentified values). However, the desktop data referred to in this report is sufficient to provide a basis for assessment of potential environmental impacts from the Project.

The following publicly available datasets have been applied over the SWLP extent in order to define existing areas of environmental value or sensitivity (full references in Appendix A):

- **Planning**
  - Planning Scheme Zoning
  - Environmental Significance Overlay
  - Vegetation Protection Overlay
  - Erosion Management Overlay
  - Land Subject to Inundation Overlay
  - Landscape significance Overlay
  - Salinity Management Overlay
  - Heritage Overlay
  - Bushfire Management Overlay
  - Cultural Heritage Sensitivity Layer

- **Topographic**
  - Watercourses
  - Waterbodies
- **Public Land**
  - Community use area
  - Earth resources
  - Historic and Cultural Features Reserve
  - Natural Features Reserve
  - Nature Conservation Reserve
  - National Park
  - Regional Park
  - Services and Utilities area
  - State Forest
  - State Park
  - Uncategorised public land
  - Water production
  - Council and water authority reserves/land
- **Native Vegetation**
  - Ecological Vegetation Class (and accompanying Biodiversity Conservation Significance)
- **Flora and Fauna**
  - Threatened flora species (Victorian biodiversity atlas)
  - Threatened fauna species (Victorian biodiversity atlas)
  - Threatened ecological communities (FFG and EPBC)
  - Biodiversity Impact and Offset Requirements (modelled)
  - EPBC Protected Matters Search

Data extracts of the Victorian Biodiversity Atlas (VBA) have been based on a 5km search buffer surrounding the project extent. A 1km buffer was applied to the project extent for the EPBC Protected Matters Search Tool (PMST). The extensive search areas applied during the flora and fauna database search are used to compensate for a potential lack of historical surveys within the project extent and its immediate surrounds. This approach also allows for the identification of mobile species such as birds which may have the potential to interact with the project extent on an intermittent and opportunistic manner. Analysis of this data has taken into consideration the ecological value and attributes of the project extent when compared to the broader landscape

An assessment has been undertaken to assess the likelihood of commonwealth and state listed threatened species occurring within proximity to the project extent based on desktop information. This method considers the habitat requirements of threatened species, as identified by desktop searches, along with how recently the species has been recorded within the search extent and quantities of past records. Due to this assessment being based on desktop information only, habitat for species identified in VBA search is unknown. Therefore, habitat for these species has been assumed present within and adjacent to the Project Extent for the purposes of this assessment. Subsequently, a greater emphasis is placed on how recent species were last recorded within the desktop search area. Following an on-

ground habitat assessment, the likelihood status of species occurring within or adjacent to the Project Extent will likely change due to the presence or absences of suitable species habitat being known.

The following criteria were applied to determine the likelihood of species occurring within the project extent.

- Known: Species recorded within the project extent within the last 5 years.
- Likely: Species recorded within or near the project in last 20 years and suitable habitat is likely to occur within the project extent.
- Possible: Species recorded within or near the project extent with records >20 years old and/or little/low quality suitable habitat occurs within the project extent.

Unlikely: Very old records (>40 years) and/or little/low/no suitable habitat within the project extent and/or other reason the species is unlikely to occur.

3.3 Environmental Asset Summary

Environmental assets tend to be closely linked to areas of public land. Native vegetation, threatened species and protective overlays tend to be overwhelmingly located within riparian corridors, road reserves and areas of Crown Land that have not been subjected to recent agricultural cultivation or forestry practices.

It is acknowledged that on-ground assessment of a preliminary design corridor is required to confirm this correlation as well as to identify any native vegetation patches or scattered trees that are not contained within the publically available datasets. However, as a planning guidance tool, it is recommended that public land exposure is minimised during preliminary design in order to minimise potential environmental impacts.

3.4 Threatened Flora Analysis (refer to EEA referral documentation for final detail)

A desktop review of threatened flora species historically recorded within 5 km of the project extent as well as flora species identified by the EPBC Act Protected Matters Search Tool was undertaken. This included 110 flora species. An assessment of the likelihood of species occurring within and surrounding the project extent was undertaken using criteria stated in Section 3.2. This assessment identified one FFG listed species as known to occur within the project extent. A further four EPBC Act species and 11 FFG Act listed species are considered likely to occur within and surrounding the project extent. Three EPBC Act species and eight FFG Act listed species are also considered Possible to occur within and surrounding the project extent.

Additionally, 93 threatened flora species have been historically recorded within 5 km of the project extent. Records include 44 species listed under the Victorian Rare or Threatened Species (VROTS) advisory lists (DEPI 2013), 22 FFG Act listed species and 9 EPBC Act listed species. Threatened species recorded in the last 20 years are listed in Table 3.

Table 3 VBA Flora Extract of threatened fauna species within 5km of the study area

Common Name	Scientific Name	EPBC	FFG	Count of records	Most recent record
Arching Flax-lily	*Dianella sp. aff. longifolia (Benambra)*			2	2010
Blue Mallee	*Eucalyptus polybractea*			85	2012
Bluish Raspwort	*Haloragis glauca f. glauca*				2012
Bramble Wattle	*Acacia victoriae subsp. victoriae*			1	2000
Branching Groundsel	*Senecio cunninghamii var. cunninghamii*			2	2000
Buloke	*Allocasuarina luehmannii*		L	29	2011
Buloke Mistletoe	*Amyema linophylla subsp. orientale*			1	2000
Cane Spear-grass	*Austrostipa breviglumis*			20	2011
Dainty Phebalium	*Phebalium festivum*		L	27	2010
Dainty Spider-orchid	*Caladenia ampla*			1	2005
Deane's Wattle	*Acacia deanei*			13	2011
Deane's Wattle	*Acacia deanei subsp. paucijuga*			18	2011
Fuzzy New Holland Daisy	*Vittadinia cuneata var. morrisii*			4	2012
Giant Hop-bush	*Dodonaea viscosa subsp. angustifolia*			1	2002
Goldfields Grevillea	*Grevillea dryophylla*			11	2000
Grey Grass-tree	*Xanthorrhoea glauca subsp. angustifolia*		L	2	2000
Half-bearded Spear-grass	*Austrostipa hemipogon*			3	2011
Inland Pomaderris	*Pomaderris paniculosa subsp. paniculosa*			21	2001
Kamarooka Mallee	*Eucalyptus froggattii*		L	27	2012
Late-flower Flax-lily	*Dianella tarda*			4	2011
Plains Joyweed	*Alternanthera sp. 1 (Plains)*			2	2012
Rosemary Grevillea	*Grevillea rosmarinifolia*			7	2000
Sand Rush	*Juncus psammophilus*			1	2011
Short-bristle Wallaby-grass	*Rytidosperma setaceum var. brevisetum*			2	2012
Small-flower Wallaby-grass	*Rytidosperma monticola*			3	2012
Small-leaf Goodenia	*Goodenia benthamiana*			8	2011

Common Name	Scientific Name	EPBC	FFG	Count of records	Most recent record
Snowy Mint-bush	*Prostanthera nivea var. nivea*			5	2002
Spiny Rice-flower	*Pimelea spinescens subsp. spinescens*	CR	L	1	2008
Stiff Groundsel	*Senecio behrianus*	EN	L	1	2003
Streaked Wattle	*Acacia lineata*			19	2011
Striped Water-milfoil	*Myriophyllum striatum*		L	4	2003
Trim Leek-orchid	*Prasophyllum aff. pyriforme (Inglewood)*			3	2003
Velvet Daisy-bush	*Olearia pannosa subsp. cardiophylla*		L	10	2007
Wedderburn Wattle	*Acacia euthycarpa subsp. oblanceolata*			7	1998
Whipstick Westringia	*Westringia crassifolia*	EN	L	1	2003/PMST
Whorled Zieria	*Zieria aspalathoides subsp. aspalathoides*		L	7	2002
Yellow Sea-lavender	*Limonium australe var. australe*			1	1997
Yellow-lip Spider-orchid	*Caladenia xanthochila*	EN	L	2	1999/PMST

CR = Critically Endangered EN = endangered, VU = vulnerable, L = Listed

3.5 Threatened Fauna Analysis (refer to EEA referral documentation for final detail)

A desktop review of threatened fauna species historically recorded within 5 km of the project extent as well as fauna species identified by the EPBC Act Protected Matters Search Tool was undertaken. This included 77 fauna species. An assessment of the likelihood of species occurring within surrounding the project extent was undertaken using criteria stated in Section 3.2. This assessment identified five EPBC Act species and 15 FFG Act listed species are considered likely to occur within surrounding the project extent. A further five EPBC Act species and 12 FFG Act listed species are considered Possible to occur within surrounding the project extent.

Additionally, 61 threatened fauna species have been historically recorded within 5 km of the project extent. Records include 49 species listed under the Victorian Rare or Threatened Species (VROTS) advisory lists (DEPI 2013), 28 FFG Act listed species and 8 EPBC Act listed species. Threatened species recorded in the last 20 years are listed in Table 3.

Threatened species recorded in the last 20 years are listed in Table 4.

Table 4 VBA Fauna Extract of threatened fauna species within 5km of the study area

Common Name	Scientific Name	EPBC	FFG	No of records	Most recent record
Birds					
Black Falcon	*Falco subniger*			7	2001
Black-eared Cuckoo	*Chrysococcyx osculans*			24	2000
Brolga	*Grus rubicunda*		L	9	2001
Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*			365	2008
Clamorous Reed Warbler	*Acrocephalus stentoreus*			17	1999
Common Greenshank	*Tringa nebularia*			2	1983/PMST
Crested Bellbird	*Oreoica gutturalis gutturalis*		L	98	2006
Diamond Firetail	*Stagonopleura guttata*		L	151	2010
Fat-tailed Dunnart	*Sminthopsis crassicaudata*			51	2002
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*		L	9	2001
Hooded Robin	*Melanodryas cucullata cucullata*		L	101	2010
Intermediate Egret	*Ardea intermedia*		L	2	2001
Little Button-quail	*Turnix velox*			2	2006
Malleefowl	*Leipoa ocellata*	VU	L	7	2006/PMST
Nankeen Night Heron	*Nycticorax caledonicus hillii*			9	2001
Painted Honeyeater	*Grantiella picta*	VU	L	37	2006/PMST
Plains-wanderer	*Pedionomus torquatus*	CR	L		2000/PMST

Common Name	Scientific Name	EPBC	FFG	No of records	Most recent record
Powerful Owl	*Ninox strenua*		L		2007
Purple-gaped Honeyeater	*Lichenostomus cratitius*			14	1999
Rainbow Bee-eater	*Merops ornatus*			107	2010/PMST
Royal Spoonbill	*Platalea regia*			7	1999
Speckled Warbler	*Chthonicola sagittatus*		L	14	2008
Spotted Harrier	*Circus assimilis*			8	2005
Swift Parrot	*Lathamus discolor*	EN	L	94	2008/PMST
White-throated Needletail	*Hirundapus caudacutus*		L	19	2000/PMST
Fishes					
Australian Mudfish	Neochanna cleaveri		L	1	2008
Mountain Galaxias	Galaxias olidus		L	8	2005
Mammals					
Fat-tailed Dunnart	*Sminthopsis crassicaudata*			51	2002
Invertebrates					
Golden Sun Moth	*Synemon plana*	CR	L	1	2008/PMST
Reptiles					
Lace Monitor	*Varanus varius*			8	2004

CR = Critically Endangered EN = endangered. VU = vulnerable, L = Listed

3.6 Ecological Vegetation Class Analysis

The Project Extent covers 289,794 ha of which 44% contains a mapped Ecological Vegetation Class (EVC). Of this, 7% or approximately 20,641 ha, are categorised as Endangered EVCs.

The EPBC Protected Matters Search identified five threatened ecological communities:

1. Buloke woodlands of the Riverina and Murray-Darling Depression Bioregions (endangered)
2. Grey Box (Eucalyptus macrocarpa) Grassy Woodlands (endangered)
3. Natural Grasslands of the Murray Valley Plains (critically endangered)
4. Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains (critically endangered)
5. White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered).

The following communities of Flora and Fauna on the FFG Threatened List may be impacted by the project:

- Butterfly Community No. 1
- Creekline Grassy Woodland (Goldfields) Community
- Grey Box - Buloke Grassy Woodland Community
- Lowland Riverine Fish Community of the Southern Murray-Darling Basin
- Northern Plains Grassland Community
- Red Gum Swamp Community No. 1
- Semi-arid Herbaceous Pine Woodland Community
- Semi-arid Herbaceous Pine-Buloke Woodland Community
- Semi-arid Northwest Plains Buloke Grassy Woodland Community
- Semi-arid Shrubby Pine-Buloke Woodland Community
- Victorian Mallee Bird Community
- Victorian Temperate Woodland Bird Community

Desktop extents of these ecological communities are indicative only and ground-truthing through on-ground ecological assessment will be required to determine their actual presence or absence.

Table 3: Significance, Bioregion and indicative area of Ecological Vegetation Classes contained within the SWLP Project Extent.

Ecological Vegetation Class	Significance	Bioregion	Approx. Ha within Project Extent
Alluvial Terraces Herb-rich Woodland	Endangered	Goldfields	136
Creekline Grassy Woodland	Endangered	Goldfields	2,209
Floodplain Riparian Woodland	Endangered	Goldfields	373
Grassy Woodland/Alluvial Terraces Herb-rich Woodland Mosaic	Endangered	Goldfields	7,265
Plains Woodland	Endangered	Goldfields	2061
Wetland Formation	Endangered	Goldfields	13
Creekline Grassy Woodland	Endangered	Victorian Riverina	737
Grassy Woodland	Endangered	Victorian Riverina	440
Grassy Woodland/Alluvial Terraces Herb-rich Woodland Mosaic	Endangered	Victorian Riverina	14

Ecological Vegetation Class	Significance	Bioregion	Approx. Ha within Project Extent
Plains Grassland	Endangered	Victorian Riverina	1,377
Plains Woodland	Endangered	Victorian Riverina	5,762
Wetland Formation	Endangered	Victorian Riverina	140
Grassy Woodland	Endangered	Wimmera	4
Plains Woodland	Endangered	Wimmera	106
Riverine Chenopod Woodland/Lignum Swamp Mosaic	Endangered	Wimmera	4
Total (Ha)			**26,641**

3.7 Water Body Analysis

There are no wetlands of national or international significance within the SWLP Project Extent. Locally important wetlands of national or international significance with proximity to the Project Extent (refer to Table 4).

Table 4: Water bodies within proximity to the Project Extent

Name	Proximity
Laanecoorie Reservoir	Within Extent
Woolshed Swamp	11.5km
Lake Marmal	12.3km
Lake Boort	15km
Lake Lyndger	19km
Bradshaw Swamp	22km

There are a total of seven watercourses listed as 'high' or 'medium' hierarchy within the Project Extent (Table 5 outlines these). Detailed design will reduce the number of these waterway crossings and will be horizontally directionally drilled.

Table 5: Watercourse Hierarchy within the Project Extent

Watercourse Name	Hierarchy
Loddon River	High
Avoca River	High
Bullabul Creek	Medium
Strathfillan Creek	Medium
Campbell Creek	Medium
Bet Bet Creek	Medium
Waranga Western Channel	Medium

In terms of stream length, low priority watercourses are by far the most prevalent within the Project Extent. The majority of these low priority watercourses are ephemeral drainage lines (natural or formalised) that have localised catchments.

Timing of construction will be critical to minimising impacts both at local site level and further downstream as cumulative impact of construction across these watercourses must be considered carefully in project planning.

Watercourse crossing methodology will be selected based on the overall significance of the site (i.e. assessment of cultural, ecological and recreational values). Principals of avoidance and minimisation will be applied.

Reinstatement of watercourse crossings is also a key consideration to ensure that the selected method of reinstatement will maintain structural integrity of the site so that the downstream environment is not materially affected.

Table 6: Length of Watercourse within Project Extent

Watercourse Hierarchy	Length within Project Extent (km)
High	159
Medium	91
Low	5,951

3.8 Cultural Heritage Sensitivity Analysis

20.5% of land within the Project extent falls within an area of cultural heritage sensitivity. The SWLP constitutes a 'high impact activity' that will be undertaken within 'an area of cultural heritage sensitivity' and therefore, a Cultural Heritage Management Plan will be required.

Interaction, engagement and proposed work will be undertaken in accordance with legislation and a Memorandum of Understanding (MoU) signed between GWMWater and the Dja Dja Wurrung Clans Aboriginal Corporation.

A CHMP (or series of CHMPs if construction will be 'staged') will be prepared as part of Project Planning prior to the commencement of 'significant ground disturbance' activities. An on-ground survey will be undertaken and report prepared as part of the detailed design phase of works.

Findings from this survey will be used to prepare the CHMP that will outline the proposed minimisation of impacts to identified sites to the satisfaction of the Dja Dja Wurrung Clans Aboriginal Corporation.

3.9 Public Land Analysis

Public land has a general tendency to contain higher values and areas of sensitivity as it tends to be less disturbed or cultivated. Some areas of native Public Land within the Project extent are subject to active use through water extraction, grazing licences or timber production whilst other parcels have additional protection provisions that limit the permitted use or activities that can be undertaken.

Table 7: Public land present within Project Extent

Public Land Descriptor	Area within Project Extent (Ha)	% of the Total Project Extent
Community Use Area	398	0.14
Earth Resources	299	0.10
Historic And Cultural Features Reserve	217	0.07
Land Not Required For Public Purposes	24	0.01
Natural Features Reserve	3359	1.16
Nature Conservation Reserve	13,301	4.59
Regional Park	928	0.32
Services And Utilities Area	684	0.24
State Forest	26,715	9.22
State Park	11,473	3.96
Uncategorised Public Land	560	0.19
Water Production	277	0.10
Total	**58,235**	**20**

3.10 Planning Scheme Analysis

The local planning scheme mapping of the Loddon Shire and Northern Grampians Shire has been referenced to highlight the presence or absence of key planning zones. Farming Zone – FZ - (78%) and Public Conservation and Resource Zone – PCRZ - (19%) combine to cover 97% of all land zoning within the Project Extent.

The construction of a minor utility installation (SWLP) is permissible in all zones except within a PCRZ. Planning permission would be required to construct a minor utility installation within a PCRZ where the proponent is not the Land Manager. By requesting a planning scheme amendment under S20(4) of the Planning and Environment Act, 1987, a planning permit would not be required provided conditions listed within the accompanying incorporated document are implemented.

Table 8: Land zoning breakdown within Project Extent

Zone Code	Area within Project Extent (Ha)	% of the Total Project Extent
C1Z	12.754	0.004
C2Z	1.032	0.0004
FZ	226,807.148	78.265
GRZ1	239.758	0.083
IN1Z	82.245	0.028
LDRZ	283.847	0.098
PCRZ	55,331.199	19.093
PPRZ	168.839	0.058
PUZ1	140.802	0.049

Zone Code	Area within Project Extent (Ha)	% of the Total Project Extent
PUZ2	5.747	0.002
PUZ3	5.554	0.002
PUZ4	687.640	0.237
PUZ5	3.760	0.001
PUZ6	4.310	0.001
PUZ7	1.478	0.001
RCZ	0.456	0.0002
RDZ1	995.229	0.343
RDZ2	48.902	0.017
RLZ	2,351.324	0.811
RLZ2	1,515.506	0.523
RLZ4	684.508	0.236
TZ	670.561	0.231

3.11 Planning Overlay Analysis

The local planning scheme mapping of the Loddon Shire and Northern Grampians Shire has been referenced to highlight the presence or absence of key planning overlays.

Whilst not definitive, planning scheme overlays provide a good indication of environmental values and threats. Land Subject to Inundation Overlay, for example, provides good information on areas that may contain ephemeral soaks or other environmental values. It also indicates which areas stay wetter for longer which can inform construction scheduling to ensure that construction is planned during drier months at these locations.

There is no land within the Project extent that is subject to the Significant Landscape overlay.

Collectively, 7.29% of the Project Extent has an overlay that has associated heritage or environmental value and should be avoided by the SWLP footprint.

45.29% of the Project Extent has an overlay that could be considered a threat to the Project (e.g. Land subject to inundation, salinity or erosion). At these locations additional consideration should be given to the need for management measures, as appropriate.

Table 9: Planning Scheme Overlay breakdown.

Scheme Overlay Code	Area_Ha	% Project Extent	% Value Overlay	% Threat Overlay
Design and Development	14.57	0.01		
Significant Landscape Overlay	0	0		
Environmental Audit	0.73	0.04		
Erosion Management	7,132.99	2.46		

Scheme Overlay Code	Area_Ha	% Project Extent	% Value Overlay	% Threat Overlay
Environmental Significance	9,957.79	3.44	3.44	
Heritage Overlay	985.51	0.34	0.34	
Land Subject to Inundation	2,787.08	0.96		0.96
LSIO-Floodway overlay	19,045.36	6.57		6.57
Public Acquisition	0.87	0.0003		
Salinity Management Overlay	19,075.75	6.58		6.58
Vegetation Protection	10,157.78	3.51	3.51	
Bushfire Management Overlay	90,344.43	31.18		31.18
	159,502.87	55.04	7.29	45.29

4. Environmental Risk Assessment Methodology

Environmental risk can be described as the potential impact that a perceived environmental threat could have on the receiving environment, expressed in terms of a combination of the consequences of an event (i.e. if the impact does eventuate, what is the extent of the outcome?) and the associated likelihood of the occurrence (i.e. how probable is the impact?).

4.1 Principal of ALARP

The concept of as low as reasonably practicable (ALARP) is used as a measure of control for any risk that cannot be eliminated entirely. ALARP is reached when the cost of further risk reduction measures is grossly disproportionate to the benefit gained from the reduced risk.

Planning commitments used to reduce a risk to ALARP must be practical and achievable and represent the full extent to which the risk can be minimised using reasonable means.

4.2 Hierarchy of Control

When preparing planning commitments, consideration must be made with reference to the hierarchy of control. For the purposes of the environmental risk assessment, the following hierarchy of control applies:

1. Eliminate the risk by:
    a. Reviewing the requirement for that impact (i.e. is the section of pipeline really required or can other parts of the system be re-designed to meet the need of supply?)
    b. Re-alignment around the environmental asset by re-design
    c. Changing the proposed construction methodology by selecting a non-impact method (i.e. trenchless solution)
    d. Re-scheduling planned works to avoid the risk (i.e. plan works to avoid seasonal risks – breeding season, fish habitat in ephemeral watercourses, etc.)

2. Substitute the risk:

    Adopting a less intrusive construction methodology (i.e. use a 'poor boy' crew that can work slowly through a narrower construction width over discrete lengths of pipeline; use 'plough-in' methodology to rip the pipeline in to reduce trafficking and ground disturbance width, directional drilling, etc.)

3. Isolate the risk:
    a. Preparing planning controls to protect identified environmental assets from construction impacts
    b. Installing physical barriers to shield active construction work from adjacent sensitive receptors.
4. Use engineering controls:

    Modifying detailed design to reduce impact.

5. Use administrative controls:
    a. Preparing a Construction Environmental Management Plan with specific commitments regarding environmental protection, monitoring and performance.
    b. Ensuring regular formalised communication during construction of identified assets and protective measures required to avoid or reduce impacts

4.3 Identification of Environmental Assets

Section 2.7.2 and Appendix B identify the range of environmental assets that have the potential to occur within the Project Extent.

It is acknowledged that a desktop assessment does not represent a full identification of potentially impacted environmental assets and that further detailed assessment is required (as outlined in Table 1).

On-ground assessment of preliminary design of the SWLP has a high likelihood of identifying further assets, as well as confirming the absence of other assets. However, for the purpose of this assessment, desktop data is deemed satisfactory to provide a high level account of environmental assets contained within the Project extent. A desktop assessment is also sufficient to enable the preparation of Planning Commitments that can be used to effectively avoid, minimise and offset the impacts of construction on these environmental assets when implemented at the appropriate time during Project execution.

4.4 Identification of Environmental Threats

Section 2.3.1 and Section 2.4 provide a detailed account of all identified threats to the environment that will be associated with the construction and operation of the SWLP. The majority of works will constitute temporary ground disturbance with a small amount of above ground infrastructure leaving a residual ongoing change in land use (pump stations, storages, installation of valves, pipeline signage, water meter points).

4.5 Determination of Likelihood

GWMWater's Risk Matrix Guide (CMS/2051 Vers3) has been referenced when preparing the likelihood criteria for the environmental risk assessment. There are five categories of likelihood as shown Table 10.

Table 10: GWMWater Likelihood Parameters

Description	Definition
Almost Certain	90% – 99.9% likelihood of occurring within one year ▪ May occur once every 6 months – 18 months ▪ May occur twice every 1.0 to 2.5 years
Likely	60% – 89% likelihood of occurring within one year ▪ May occur once every 18 months – 3 years ▪ May occur twice every 3 to six 6 years
Possible	20% – 59% likelihood of occurring within one year ▪ May occur once every 3 years to 6 years ▪ May occur twice every 6 to 12 years

Description	Definition
Unlikely	5% – 19% likelihood of occurring within one year ▪ May occur once every 6 to 20 years ▪ May occur twice every 12 to 40 years
Rare	0.1% – 4.9% likelihood of occurring within one year ▪ May only occur every 20 years to 1,000 years

4.6 Evaluation of Consequence

It is CNC's experience that when undertaking environmental risk analysis for pipeline construction projects, consequence criteria does not alter greatly once planning commitments have been applied.

The ultimate consequence for each identified risk remains the same; it is the appropriateness of the nature and scale of the planning commitment that reduces the likelihood and thus the overall risk of environmental harm.

Thus, 'Consequence' criteria were not a key consideration for the threat assessment. Instead, focus was placed on identifying planning commitments that were appropriate to the nature and scale of each risk in order to develop an overarching management commitment that reduced the likelihood of each risk to an acceptable level.

4.7 Environmental Risk Analysis

GWMWater undertook an environmental risk analysis on Tuesday, 4th October. The assessment involved key members of the Project team and was focussed on generating planning commitments that are reasonable and practical in both a planning and construction sense.

The purpose of session was to create the basis for the SWLP environmental planning framework through thorough evaluation of identified environmental risk. Having constructed close to 10,000km of water pipeline in the last ten years, the GWMWater team had a very good concept of the threats and risks associated with pipeline.

The EMF will provide the overarching structure and guidance that will be ingrained in the development of all environmental planning documentation throughout the Project.

The environmental risk session focused on review of desktop datasets prepared by CNC that visually reflected the data presented in Section 3 and reflected the structure of Part 2 of the referral form for the EE Act to ensure consistency with the regulatory interpretation of environmental assets/values.

This provided the risk assessment team with a good understanding of the indicative quantity and location of environmental assets and the structure in which they should be presented in when considering the impact of Project threats.

There was a clear imperative to achieve a balance between consistency with regulatory intent and practicality of construction.

In the absence of preliminary design of the system, there was a heavy emphasis placed on implementing planning commitments over a broader area (the Project Extent) rather than a defined project envelope (a maximum area that is contained within 0.79% of the total Project Extent area). Thus, at this stage in the process, a far greater number of environmental values and assets were identified within the wider Project Extent than will ultimately be impacted by the physical construction of the SWLP.

The design and assessment portion of the proposed contracted works will by its nature allow areas of identified high value or sensitivity to be identified and avoided or minimised using a range of approaches and techniques that are consistent with the Hierarchy of Control (Section 4.2).

A CEMP will be prepared to describe the proposed site specific application of avoidance, minimisation and focus on specific management measures of the remaining residual impacts.

4.8 Presentation of the Environmental Risk Analysis

The environmental risk analysis is presented in Appendix CC. This will form the basis for assessment against EEC Act and EPBC Act referral criteria.

5. Case Study: South West Loddon Rural Water Supply Project Stage one

Stage one of the SWLP is currently undergoing construction. It has been developed under an independent business case and at the time of its planning, there was no intention to expand the water supply project any further than the 110km that comprise the works package.

Subsequently, the Stage 2 package has been prepared under a separate business case and funding model which introduced the 'Stage 1/ Stage 2' nomenclature that serves to act as a point of separation between the works. There is a clear point of separation between the two capital works projects and they should be viewed as separate Projects from a planning perspective.

Stage 1 capital works are very similar to the proposed Stage 2 works. GWMWater proposes to apply the same methodology and approach to the construction of Stage 2 as have been applied to the construction of Stage 1.

This places Stage 1 as a very useful case study of the same water corporation presiding over similar planning and construction process in an adjacent area. Both of the Stage 1 and Stage 2 Projects aim to achieve the ultimate goal of optimising construction of a new pressurised water delivery system to limit its impact on existing environmental assets through the effective application of agreed planning principles and commitments. This approach focusses the benefits of the system on the positive social good that is created through a secure, consistent supply of stock and domestic water and ensures that construction is planned and executed in an environmentally responsible way.

5.1 Primary Principles of Alignment Selection

The primary principles of alignment selection were adopted in the preliminary design phase as follows:

1. Align proposed pipeline corridor typically 8m inside private properties (largely within Farm Zone land that is subject to intensive grazing or ongoing cultivation) to avoid impacts on native vegetation and biodiversity.
2. Where native vegetation is identified:
    - Avoid through realignment – **Minor:** move the pipeline to the opposite side of the road or further out into the paddock. **Major**: re-design to a completely new route that has less environmental impact but still achieve the same delivery targets.
    - Reduce impact. Adoption of an alternative construction methodology that requires less construction width (for example, reduce from 15m to 8m) in order to install the pipeline. This approach limits the vegetation losses and is a very effective way of minimising impacts of construction.
    - Avoid through Horizontal Directional Drilling (HDD) to a depth greater than 600mm. Site selection process where HDD avoidance has been selected will be documented in the CEMP.

5.2 Application of Principles

In applying the primary principles of alignment selection, the project planning team for Stage 1 were able to achieve the following results:

- 62% of habitat zone extent identified within the corridor during survey was avoided.
- Minor realignment of the pipeline corridor accounted for approximately 45% of all avoidance, including 100% of scattered trees.
- 17% of avoidance of identified habitat zone extent was undertaken via HDD.
- HDD applies to all water crossings.

35% of the identified habitat zone were accepted as a 'worst case' for the purpose of offset planning and will be revisited following completion of construction and assessed for construction impact with the expectation that a lot of these sites will not have been materially damaged by construction of the pipeline.

Table 11: Management of habitat zone extent

Alignment Principle	Habitat Zone Extent	Percentage
Avoided via HDD	0.349	16.95
Avoided via realignment	0.928	45.09
Avoided not on alignment	0.002	0.09
Losses accepted	0.006	0.29
Losses accepted (potential to HDD)	0.734	35.66
Losses accepted (unable to HDD)	0.039	1.89
Total	2.058	100

5.3 Threatened Species Management Approach

Where threatened species have been identified, the Project has been responsive to these areas.

During on-ground assessment of Stage 1 works, the ecology team identified a number of areas of potential Golden Sun Moth habitat. These areas did not constitute native vegetation under the planning scheme as they were mostly native grasses recolonising previously cleared cropped land.

The ecology survey was out of season (i.e. the presence or absence of Golden Sun Moth could not be determined absolutely due to the narrow survey period in late spring). The primary principles of alignment selection were applied with the following outcomes:

1. 3,150m of potential Golden Sun Moth habitat was avoided by minor realignment to the opposite side of the road or further out into the paddock.

2. 190m of potential Golden Sun Moth habitat was avoided by HDD.

3. Construction works through 4,500 linear metres of potential Golden Sun Moth habitat has been deferred, pending seasonal survey for the species. Work has progressed in other areas of the system that are less sensitive and will be scheduled in the areas of potential Golden Sun Moth habitat areas following survey which can define the presence or absence of Golden Sun Moth.

Allowing for this approach, GWMWater can be confident that Golden Sun Moth habitat has been adequately assessed and impacts minimised.

It is proposed that the same approach is applied to rare or threatened species habitat during the assessment for the Stage 2 Project, where timing of survey (or other survey limitation) means that presence or absence cannot be definitively assessed.

If additional management controls are required following identification of an unavoidable impact, site specific management plans will be prepared that will outline specific management measures required to minimise that impact.

6. Conclusion

Assessment of available data sources (Appendix A) has identified a wide range of environmental assets within the Project Extent.

It is acknowledged that on-ground assessment of a preliminary design corridor is required to confirm presence or absence of environmental assets as well as to identify any native vegetation patches or scattered trees that are not contained within the publically available datasets. This will be undertaken in accordance with Table 2.

Assessment of potential Project impacts and the risk they present to identified Environmental assets has been assessed (Appendix C) with Planning Commitments being developed and agreed upon as reasonable and practicable measures to reduce each risk to an acceptable level.

The planning commitments identified in the Environmental Risk Assessment are consistent with the planning methodology for Stage one design and construction as demonstrated by the Case Study.

Stage 2 planning methodology will be reflective of Stage 1 and will form the basis of the SWLP's Environmental Management Framework (EMF).

The EMF will be used to guide the Planning process for the Project and form a defined list of planning commitments and activities that will combine to form the basis for design and construction of the SWLP which will be focussed on minimising the environmental impacts during construction and operation of the SWLP.

Appendices

Appendix A: Reference Database

Data Sources				
Layer	**Source**	**Source Layer**	**Metadata**	**GIS Process**
CH_SENSITIVITY_All.kmz	https://www.data.vic.gov.au/	sensitivity_public.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803005653&publicId=guest&extractionProviderId=1	Clipped to project extent
CH_SENSITIVITY_by_Registered.kmz	https://www.data.vic.gov.au/	sensitivity_public.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803005653&publicId=guest&extractionProviderId=1	Clipped to project extent
ENV_WATERCOURSE_H.kmz	https://www.data.vic.gov.au/	hy_watercourse.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803002489&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by hierarchy
ENV_WATERCOURSE_M.kmz	https://www.data.vic.gov.au/	hy_watercourse.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803002489&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by hierarchy
ENV_WATERCOURSE_L.kmz	https://www.data.vic.gov.au/	hy_watercourse.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803002489&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by hierarchy
NV2005_EVCBCS_All.kmz	https://www.data.vic.gov.au/	nv2005_evcbcs.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803003495&publicId=guest&extractionProviderId=1	Clipped to project extent
NV2005_EVCBCS_by_EVCDESC.kmz	https://www.data.vic.gov.au/	nv2005_evcbcs.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803003495&publicId=guest&extractionProviderId=1	Clipped to project extent; dissolved by BIOREGION and EVCDESC; calculate area ha
NV2005_EVCBCS_by_EVCNAME.kmz	https://www.data.vic.gov.au/	nv2005_evcbcs.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803003495&publicId=guest&extractionProviderId=1	Clipped to project extent; dissolved by BIOREGION, EVCDESC and EVCNAME; calculate area ha
PLANNING_OVERLAY_ALL_Dissolve.kmz	https://www.data.vic.gov.au/	plan_overlay.shp	http://services.land.vic.gov.au/SpatialDatamart/dataSearchViewMetadata.html?anzlicId=ANZVI0803002864&extractionProviderId=1	Clipped to project extent; dissolved by SCHMCODE; calculate area ha
PLANNING_OVERLAY_BUSHFIRE.kmz	https://www.data.vic.gov.au/	plan_overlay.shp	http://services.land.vic.gov.au/SpatialDatamart/dataSearchViewMetadata.html?anzlicId=ANZVI0803002864&extractionProviderId=1	Clipped to project extent; seperated by SCHMCODE
PLANNING_OVERLAY_ENV_SIGNIFICANCE.kmz	https://www.data.vic.gov.au/	plan_overlay.shp	http://services.land.vic.gov.au/SpatialDatamart/dataSearchViewMetadata.html?anzlicId=ANZVI0803002864&extractionProviderId=1	Clipped to project extent; seperated by SCHMCODE
PLANNING_OVERLAY_EROSION.kmz	https://www.data.vic.gov.au/	plan_overlay.shp	http://services.land.vic.gov.au/SpatialDatamart/dataSearchViewMetadata.html?anzlicId=ANZVI0803002864&extractionProviderId=1	Clipped to project extent; seperated by SCHMCODE
PLANNING_OVERLAY_HERITAGE.kmz	https://www.data.vic.gov.au/	plan_overlay.shp	http://services.land.vic.gov.au/SpatialDatamart/dataSearchViewMetadata.html?anzlicId=ANZVI0803002864&extractionProviderId=1	Clipped to project extent; seperated by SCHMCODE
PLANNING_OVERLAY_LSIO-FO.kmz	https://www.data.vic.gov.au/	plan_overlay.shp	http://services.land.vic.gov.au/SpatialDatamart/dataSearchViewMetadata.html?anzlicId=ANZVI0803002864&extractionProviderId=1	Clipped to project extent; seperated by SCHMCODE
PLANNING_OVERLAY_VEG_PROTECT.kmz	https://www.data.vic.gov.au/	plan_overlay.shp	http://services.land.vic.gov.au/SpatialDatamart/dataSearchViewMetadata.html?anzlicId=ANZVI0803002864&extractionProviderId=1	Clipped to project extent; seperated by SCHMCODE
PLANNING_ZONE_ALL_Dissolve.kmz	https://www.data.vic.gov.au/	plan_zone.shp	http://services.land.vic.gov.au/SpatialDatamart/dataSearchViewMetadata.html?anzlicId=ANZVI0803002864&extractionProviderId=1	Clipped to project extent; dissolved by ZONE_CODE; calculate area ha
PLANNING_ZONE_PCRZ.kmz	https://www.data.vic.gov.au/	plan_zone.shp	http://services.land.vic.gov.au/SpatialDatamart/dataSearchViewMetadata.html?anzlicId=ANZVI0803002864&extractionProviderId=1	Clipped to project extent; seperated by ZONE_CODE
PUBLIC_LAND_ALL_Dissolve.kmz	https://www.data.vic.gov.au/	TBC	TBC	Clipped to project extent; dissolved by RECNAME; calculate area ha
PUBLIC_LAND_RESERVE_STATE.kmz	https://www.data.vic.gov.au/	TBC	TBC	Clipped to project extent; seperated by RECNAME where = Reserve or State Land or State Forest
SWLPP Project Extent (289794Ha).kmz	GMW Water	SWLPP_Boundaries.shp		Supplied by GMW Water and adjusted by CNC
VBA_FAUNA25_All.kmz	https://www.data.vic.gov.au/	VBA_FAUNA25.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004161&publicId=guest&extractionProviderId=1	Clipped to project extent
VBA_FAUNA25_EPBC_DESC.kmz	https://www.data.vic.gov.au/	VBA_FAUNA25.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004161&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by EPBC
VBA_FAUNA25_FFG_Act.kmz	https://www.data.vic.gov.au/	VBA_FAUNA25.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004161&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by FFG
VBA_FAUNA25_VIC_ADV_DESC.kmz	https://www.data.vic.gov.au/	VBA_FAUNA25.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004161&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by VICADV
VBA_FAUNA100_All.kmz	https://www.data.vic.gov.au/	VBA_FAUNA100.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004160&publicId=guest&extractionProviderId=1	Clipped to project extent
VBA_FAUNA100_EPBC_DESC.kmz	https://www.data.vic.gov.au/	VBA_FAUNA100.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004160&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by EPBC
VBA_FAUNA100_FFG_Act.kmz	https://www.data.vic.gov.au/	VBA_FAUNA100.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004160&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by FFG
VBA_FAUNA100_VIC_ADV_DESC.kmz	https://www.data.vic.gov.au/	VBA_FAUNA100.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004160&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by VICADV
VBA_FLORA25_All.kmz	https://www.data.vic.gov.au/	VBA_FLORA25.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004163&publicId=guest&extractionProviderId=1	Clipped to project extent
VBA_FLORA25_EPBC_DESC.kmz	https://www.data.vic.gov.au/	VBA_FLORA25.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004163&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by EPBC

Data Sources				
Layer	**Source**	**Source Layer**	**Metadata**	**GIS Process**
VBA_FLORA25_FFG_Act.kmz	https://www.data.vic.gov.au/	VBA_FLORA25.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004163&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by FFG
VBA_FLORA25_VIC_ADV_DESC.kmz	https://www.data.vic.gov.au/	VBA_FLORA25.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004163&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by VICADV
VBA_FLORA100_All.kmz	https://www.data.vic.gov.au/	VBA_FLORA100.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004162&publicId=guest&extractionProviderId=1	Clipped to project extent
VBA_FLORA100_EPBC_DESC.kmz	https://www.data.vic.gov.au/	VBA_FLORA100.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004162&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by EPBC
VBA_FLORA100_FFG_Act.kmz	https://www.data.vic.gov.au/	VBA_FLORA100.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004162&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by FFG
VBA_FLORA100_VIC_ADV_DESC.kmz	https://www.data.vic.gov.au/	VBA_FLORA100.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004162&publicId=guest&extractionProviderId=1	Clipped to project extent; seperated by VICADV
VBIOREG100.kmz	https://www.data.vic.gov.au/	VBIOREG100.shp	http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803002636&publicId=guest&extractionProviderId=1	Clipped to project extent

Appendix B: Detailed Species Listing

Threatened Fauna Species Records within the Project Extent

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Amphibians							
Brown Toadlet	*Pseudophryne bibronii*		L	en	56	1996	Possible
Growling Grass Frog	*Litoria raniformis*	VU	L	en	8	1960/PMST	Unlikely
Birds							
Australasian Shoveler	*Anas rhynchotis*			vu	2	1981	Possible
Australian Bittern	*Botaurus poiciloptilus*	EN	L			PMST	Unlikely
Australian Painted Snipe	*Rostratula australis*	EN	L			PMST	Unlikely
Barking Owl	*Ninox connivens connivens*		L	en	5	1981	Possible
Black Falcon	*Falco subniger*			vu	7	2001	Likely
Black-eared Cuckoo	*Chrysococcyx osculans*			nt	24	2000	Likely
Black-faced Monarch	*Monarcha melanopsis*					PMST	Unlikely
Brolga	*Grus rubicunda*		L	vu	9	2001	Likely
Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*			nt	365	2008	Possible

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Bush Stone-curlew	*Burhinus grallarius*		L	en	3	1987	Possible
Caspian Tern	*Hydroprogne caspia*		L	nt	1	1983	Possible
Cattle Egret	*Ardea ibis*				5	1983/PMST	Possible
Cattle Egret	*Ardea ibis*				5	1983	Possible
Clamorous Reed Warbler	*Acrocephalus stentoreus*				17	1999	Likely
Common Greenshank	*Tringa nebularia*			vu	2	1983	Possible
Common Greenshank	*Tringa nebularia*			vu	2	1983/PMST	Possible
Crested Bellbird	*Oreoica gutturalis gutturalis*		L	nt	98	2006	Likely
Curlew Sandpiper	*Calidris ferruginea*	CR	L			PMST	Unlikely
Diamond Dove	*Geopelia cuneata*		L	nt	7	1992	Possible
Diamond Firetail	*Stagonopleura guttata*		L	nt	151	2010	Likely
Double-banded Plover	*Charadrius bicinctus*				1	1978	Possible
Eastern Curlew, Far Eastern Curlew	*Numenius madagascariensis*	CR	L			PMST	Unlikely
Eastern Great Egret	*Ardea modesta*		L	vu	2	1983	Possible

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Fork-tailed Swift	*Apus pacificus*				5	1986	Possible
Fork-tailed Swift	*Apus pacificus*				5	1986/PMST	Possible
Great Egret, White Egret	*Ardea alba*					PMST	Possible
Grey Falcon	*Falco hypoleucos*		L	en	2	1980	Possible
Grey Goshawk	*Accipiter novaehollandiae novaehollandiae*		L	vu	1	1992	Possible
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*		L	en	9	2001	Likely
Hooded Robin	*Melanodryas cucullata cucullata*		L	nt	101	2010	Likely
Intermediate Egret	*Ardea intermedia*		L	en	2	2001	Likely
Latham's Snipe, Japanese Snipe	*Gallinago hardwickii*		N			PMST	Unlikely
Little Button-quail	*Turnix velox*			nt	2	2006	Likely
Malleefowl	*Leipoa ocellata*	VU	L	en	7	2006/PMST	Likely
Musk Duck	*Biziura lobata*			vu	3	1981	Possible
Nankeen Night Heron	*Nycticorax caledonicus hillii*			nt	9	2001	Likely
Painted Honeyeater	*Grantiella picta*	VU	L	vu	37	2006/PMST	Likely

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Pied Cormorant	*Phalacrocorax varius*			nt		1983	Possible
Plains-wanderer	*Pedionomus torquatus*	CR	L	cr		2000/PMST	Likely
Powerful Owl	*Ninox strenua*		L	vu		2007	Likely
Purple-gaped Honeyeater	*Lichenostomus cratitius*			vu	14	1999	Likely
Rainbow Bee-eater	*Merops ornatus*				107	2010/PMST	Likely
Regent Honeyeater	*Anthochaera phrygia*	CR	L	cr	5	1986/PMST	Possible
Royal Spoonbill	*Platalea regia*			nt	7	1999	Likely
Rufous Fantail	*Rhipidura rufifrons*					1975	Unlikely
Rufous Fantail	*Rhipidura rufifrons*					1975/PMST	Unlikely
Satin Flycatcher	*Myiagra cyanoleuca*				1	1985	Possible
Satin Flycatcher	*Myiagra cyanoleuca*				1	1985/PMST	Possible
Sharp-tailed Sandpiper	*Calidris acuminata*				1	1983	Possible
Speckled Warbler	*Chthonicola sagittatus*		L	vu	14	2008	Likely
Spotted Harrier	*Circus assimilis*			nt	8	2005	Likely

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Spotted Quail-thrush	*Cinclosoma punctatum*			nt		1980	Possible
Superb Parrot	*Polytelis swainsonii*	VU	L			PMST	Unlikely
Swift Parrot	*Lathamus discolor*	EN	L	en	94	2008/PMST	Likely
Turquoise Parrot	*Neophema pulchella*		L	nt	2	1992	Possible
Whiskered Tern	*Chlidonias hybridus javanicus*			nt	1	1983	Possible
White-bellied Sea-Eagle	*Haliaeetus leucogaster*		L			PMST	Unlikely
White-throated Needletail	*Hirundapus caudacutus*		L	vu	19	2000/PMST	Likely
Yellow Wagtail	*Motacilla flava*					PMST	Unlikely
Fish							
Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	*Galaxias rostratus*	CR	I			PMST	Unlikely
Golden Perch	*Macquaria ambigua*		X	nt	9	1994	Possible
Murray Cod	*Maccullochella peelii*	VU	L	vu	8	1995/PMST	Possible

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Invertebrate							
Golden Sun Moth	*Synemon plana*	CR	L	cr	1	2008/PMST	Likely
Mammals							
Brush-tailed Phascogale	*Phascogale tapoatafa*		L	vu	3	1996	Likely
Common Dunnart	*Sminthopsis murina murina*			vu		1989	Possible
Corben's Long-eared Bat, South-eastern Long-eared Bat	*Nyctophilus corbeni*	VU				PMST	Unlikely
Fat-tailed Dunnart	*Sminthopsis crassicaudata*			nt	51	2002	Likely
Grey-headed Flying-fox	*Pteropus poliocephalus*	VU					Unlikely
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern)	*Isoodon obesulus obesulus*	EN	L			PMST	Unlikely
Reptiles							
Bandy Bandy	*Vermicella annulata*		L	vu	2	1990	Possible
Bearded Dragon	*Pogona barbata*			vu	12	1996	Possible
Lace Monitor	*Varanus varius*			en	8	2004	Likely

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Pink-tailed Worm-lizard, Pink-tailed Legless Lizard	*Aprasia parapulchella*	VU	L			PMST	Unlikely
Striped Legless Lizard	*Delma impar*	VU	L			PMST	Unlikely
Woodland Blind Snake	*Ramphotyphlops proximus*			nt	45	1996	Possible

EPBC – *Environment Protection and Biodiversity Conservation Act 1999*

EX – Extinct CR – Critically Endangered MA – Marine

EN – Endangered VU – Vulnerable MI – Migratory

VROT – Victorian rare and threatened species

EX – presumed extinct CR – Critically Endangered EN – endangered

VU – vulnerable NT – near threatened DD – data deficient

FFG – Flora and Fauna Guarantee Act 1988:

L – listed as threatened P – listed as protected X – Removed

Listed migratory species that may occur within the Project Extent

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Black-faced Monarch	*Monarcha melanopsis*					PMST	Unlikely
Common Greenshank	*Tringa nebularia*			vu	2	1983/ PMST	Possible

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Curlew Sandpiper	*Calidris ferruginea*	CR	L			PMST	Unlikely
Eastern Curlew, Far Eastern Curlew	*Numenius madagascariensis*	CR	L			PMST	Unlikely
Fork-tailed Swift	*Apus pacificus*				5	1986/ PMST	Possible
Latham's Snipe, Japanese Snipe	*Gallinago hardwickii*		N			PMST	Unlikely
Rufous Fantail	*Rhipidura rufifrons*					1975/ PMST	Unlikely
Satin Flycatcher	*Myiagra cyanoleuca*				1	1985/ PMST	Possible
White-throated Needletail	*Hirundapus caudacutus*		L	vu	19	2000/ PMST	Likely
Yellow Wagtail	*Motacilla flava*					PMST	Unlikely

ER = critically endangered EN = endangered. VU = vulnerable, L = Listed

In addition to the EPBC and FFG species list, the Victorian Biodiversity Atlas_25 dataset contains the following Victorian advisory listed fauna species that have been previously recorded with in the Project Extent:

Fauna Species	Victorian Advisory List Status
Bearded Dragon	Vulnerable
Common Dunnart	Vulnerable
Hardhead	Vulnerable
Musk Duck	Vulnerable
Black Falcon	Vulnerable
White-throated needletail	Vulnerable
Purple-gaped honeyeater	Vulnerable
Fat Tailed Dunnart	Near Threatened
Woodland Blind Snake	Near Threatened
Brown Treecreeper (south-eastern spp.)	Near Threatened
Black eared cuckoo	Near Threatened
Spotted Quail Thrush	Near Threatened
Little Button Quail	Near Threatened
Spotted Harrier	Near Threatened
Royal Spoonbill	Near Threatened
Nankeen Night Heron	Near Threatened
Lace Monitor	Endangered

EPBC and FFG Threatened Flora Species

Table 12 Likelihood of threatened flora

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Annual Buttercup	*Ranunculus sessiliflorus var. pilulifer*			k	1	1979	Possible
Arching Flax-lily	*Dianella sp. aff. longifolia (Benambra)*			v	2	2010	Likely

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Ausfeld's Wattle	*Acacia ausfeldii*		X	v	15		Possible
Bent-leaf Wattle	*Acacia flexifolia*			r	10	1995	Possible
Blue Mallee	*Eucalyptus polybractea*			r	85	2012	Likely
Bluish Raspwort	*Haloragis glauca f. glauca*			k		2012	Known
Bramble Wattle	*Acacia victoriae subsp. victoriae*			r	1	2000	Likely
Branching Groundsel	*Senecio cunninghamii var. cunninghamii*			r	2	2000	Likely
Brilliant Sun-orchid	*Thelymitra mackibbinii*	VU	L	e		PMST	Unlikely
Broad-lip Diuris	*Diuris X palachila*			r	1	1992	Possible
Buloke	*Allocasuarina luehmannii*		L	e	29	2011	Likely
Buloke Mistletoe	*Amyema linophylla subsp. orientale*			v	1	2000	Likely
Candy Spider-orchid	*Caladenia versicolor*	VU	L	e		PMST	Unlikely
Cane Spear-grass	*Austrostipa breviglumis*			r	20	2011	Likely
Clover Glycine, Purple Clover	*Glycine latrobeana*	VU	L	v		PMST	Unlikely

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Club-hair New Holland Daisy	*Vittadinia condyloides*			r	3	1996	Possible
Coast Stork's-bill	*Pelargonium littorale*			k	1	1952	Unlikely
Coccid Emu-bush	*Eremophila gibbifolia*			r	4	1950	Unlikely
Common Beard-heath	*Leucopogon virgatus var. brevifolius*			r	1	1770	Unlikely
Common Fringe-sedge	*Fimbristylis dichotoma*			v	3	1981	Possible
Common Morel	*Morchella esculenta*			v	1	1770	Unlikely
Common Pipewort	*Eriocaulon scariosum*			r	1	1990	Possible
Common Sour-bush	*Choretrum glomeratum*			P	2	1991	Possible
Crimson Sun-orchid	*Thelymitra X macmillanii*			v	2	1932	Unlikely
Dainty Phebalium	*Phebalium festivum*		L	v	27	2010	Likely
Dainty Spider-orchid	*Caladenia ampla*			e	1	2005	Likely
Dark Roly-poly	*Sclerolaena muricata var. semiglabra*			k	1	1989	Possible
Deane's Wattle	*Acacia deanei*			P	13	2011	Likely

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Deane's Wattle	*Acacia deanei subsp. paucijuga*			r	18	2011	Likely
Diosma Rice-flower	*Pimelea flava subsp. dichotoma*			r	5	1987	Possible
Downy Swainson-pea	*Swainsona swainsonioides*		L	e	1	1992	Possible
Dwarf Cassinia	*Cassinia diminuta*			r	5	1992	Possible
Erect Peppercress	*Lepidium pseudopapillosum*	VU	L	e	1	1995/PMST	Possible
Flat Spike-sedge	*Eleocharis plana*			v	1	1994	Possible
Floodplain Rustyhood	*Pterostylis cheraphila*	VU	L	v		PMST	Unlikely
Foot Triggerplant	*Stylidium ecorne*			k		1981	Possible
Fuzzy New Holland Daisy	*Vittadinia cuneata var. morrisii*			r	4	2012	Likely
Giant Hop-bush	*Dodonaea viscosa subsp. angustifolia*			r	1	2002	Likely
Goldfield Boronia	*Boronia anemonifolia subsp. aurifodina*			r	2	1987	Possible
Goldfields Grevillea	*Grevillea dryophylla*			r	11	2000	Likely

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Green Leek-orchid	*Prasophyllum lindleyanum*		X	v	5	1981	Possible
Greencomb Spider-orchid, Rigid Spider-orchid	*Caladenia tensa*	EN				PMST	Unlikely
Green-strap Star-liverwort	*Asterella tenera*			k	1	1955	Unlikely
Grey Grass-tree	*Xanthorrhoea glauca subsp. angustifolia*		L	e	2	2000	Likely
Grey Podolepis	*Podolepis canescens*			r	1	1861	Unlikely
Hairy Hop-bush	*Dodonaea boroniifolia*			r	4	1981	Possible
Hairy Tails	*Ptilotus erubescens*		L	v	7	1996	Possible
Half-bearded Spear-grass	*Austrostipa hemipogon*			r	3	2011	Likely
Hoary Sunray, Grassland Paper-daisy	*Leucochrysum albicans var. tricolor*	EN				PMST	Unlikely
Inland Pomaderris	*Pomaderris paniculosa subsp. paniculosa*			v	21	2001	Likely
Ivy-leaf Duckweed	*Lemna trisulca*			k	1	1994	Possible
Kamarooka Mallee	*Eucalyptus froggattii*		L	r	27	2012	Known

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Late-flower Flax-lily	*Dianella tarda*			v	4	2011	Likely
Marbled Marshwort	*Nymphoides spinulosperma*		L	e	5	1996	Likely
McIvor Spider-orchid, Audas Spider-orchidCaladenia audasii	*Caladenia audasii*	EN	L	e		PMST	Unlikely
Pale Leek-orchid	*Prasophyllum pallidum*	VU				PMST	Unlikely
Pale Spike-sedge	*Eleocharis pallens*			k	4	1996	Possible
Plain Quillwort	*Isoetes drummondii subsp. anomala*			k	1	1979	Possible
Plains Joyweed	*Alternanthera sp. 1 (Plains)*			k	2	2012	Likely
Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea	*Pimelea spinescens subsp. spinescens*	CE				PMST	Unlikely
Purple Eyebright	*Euphrasia collina subsp. muelleri*	EN	L	e	1	1770	Unlikely
Rayless Daisy-bush	*Olearia tubuliflora*			r	2	1990	Possible
Red Darling-pea, Red Swainson-pea	*Swainsona plagiotropis*	VU	L	e	1	1992/PMST	Possible

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
River Swamp Wallaby-grass, Floating Swamp Wallaby-grass	*Amphibromus fluitans*	VU				PMST	Unlikely
Rosemary Grevillea	*Grevillea rosmarinifolia*			P	7	2000	Likely
Rough Wattle	*Acacia aspera subsp. parviceps*			r	1	PMST	Unlikely
Rye Beetle-grass	*Tripogon loliiformis*			r	1	1981	Possible
Sand Brome	*Bromus arenarius*			r	1	1981	Possible
Sand Rush	*Juncus psammophilus*			r	1	2011	Likely
Short-bristle Wallaby-grass	*Rytidosperma setaceum var. brevisetum*			r	2	2012	Likely
Sikh's Whiskers	*Pterostylis boormanii*			r	4	1995	Possible
Silky Swainson-pea	*Swainsona sericea*		L	v	1	1996	Possible
Slender Club-sedge	*Isolepis congrua*		L	v	3	1981	Possible
Slender Darling-pea, Slender Swainson, Murray Swainson-pea	*Swainsona murrayana*	VU				PMST	Unlikely
Small-flower Grevillea	*Grevillea micrantha*			r	9	1992	Possible

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Small-flower Wallaby-grass	*Rytidosperma monticola*			r	3	2012	Likely
Small-leaf Goodenia	*Goodenia benthamiana*			r	8	2011	Likely
Smooth Nardoo	*Marsilea mutica*			k	1	1994	Possible
Snowy Mint-bush	*Prostanthera nivea var. nivea*			r	5	2002	Likely
Southern Swainson-pea	*Swainsona behriana*			r	2	1996	Possible
Spear-grass	*Austrostipa trichophylla*			r	2	1990	Possible
Spike Grass	*Elytrophorus spicatus*			k	1	1980	Possible
Spiny Lignum	*Duma horrida subsp. horrida*			r	1	1994	Possible
Spiny Rice-flower	*Pimelea spinescens subsp. spinescens*	CR	L	e	1	2008	Likely
Spiral Sun-orchid	*Thelymitra matthewsii*	VU	L	v		PMST	Unlikely
Stiff Groundsel	*Senecio behrianus*	EN	L	e	1	2003	Likely
Stiff Groundsel	*Senecio behrianus*	EN	L	e		PMST	Unlikely
Streaked Wattle	*Acacia lineata*			r	19	2011	Likely

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Striped Water-milfoil	*Myriophyllum striatum*		L	v	4	2003	Likely
Swamp Diuris	*Diuris palustris*		L	v	1	1979	Possible
Tiny Bog-sedge	*Schoenus nanus*			r	13	1985	Possible
Trailing Hop-bush	*Dodonaea procumbens*	VU		v		PMST	Unlikely
Trim Flat-sedge	*Cyperus concinnus*			v	1	1994	Possible
Trim Leek-orchid	*Prasophyllum aff. pyriforme (Inglewood)*			e	3	2003	Likely
Turnip Copperburr	*Sclerolaena napiformis*	EN	L	e		PMST	Unlikely
Umbrella Wattle	*Acacia oswaldii*		N	v	1	2011	Likely
Velvet Daisy-bush	*Olearia pannosa subsp. cardiophylla*		L	v	10	2007	Likely
Wedderburn Wattle	*Acacia euthycarpa subsp. oblanceolata*			v	7	1998	Likely
Western Golden-tip	*Goodia medicaginea*			r	2	1981	Possible
Western Pellitory	*Parietaria australis*			r	1	1960	Unlikely
Whipstick Crowea	*Crowea exalata subsp. revoluta*			v		1951	Unlikely

Common Name	Scientific Name	EPBC	FFG	VROT	Count	Most recent record	Likelihood
Whipstick Westringia	*Westringia crassifolia*	EN	L	e	1	2003/PMST	Likely
Whirrakee Wattle	*Acacia williamsonii*		X	r	10	2000	Likely
Whorled Zieria	*Zieria aspalathoides subsp. aspalathoides*		L	v	7	2002	Likely
Winged Water-starwort	*Callitriche umbonata*		X	r	4	1981	Possible
Yelka	*Cyperus victoriensis*			k	1	1994	Possible
Yellow Sea-lavender	*Limonium australe var. australe*			r	1	1997	Likely
Yellow-lip Spider-orchid	*Caladenia xanthochila*	EN	L	e	2	1999/PMST	Likely

EPBC – *Environment Protection and Biodiversity Conservation Act 1999*

EX – Extinct CR – Critically Endangered

EN – Endangered VU – Vulnerable

VROT – Victorian rare and threatened species

x – presumed extinct cr – Critically Endangered e – endangered

v – vulnerable r – rare

k – poorly known

FFG – Flora and Fauna Guarantee Act 1988:

L – listed as threatened P – listed as protected X – Removed

In addition to the EPBC and FFG species list, the Victorian Biodiversity Atlas_25 dataset contains the following Victorian advisory listed fauna species that have been previously recorded with in the Project Extent:

Flora Species	Victorian Advisory List Status
Ausfeld's Wattle	Vulnerable
River red gum	Vulnerable
Cut-leaf burr-daisy	Vulnerable
Velvet daisy bush	Vulnerable
Whorled Zieria	Vulnerable
Dainty Phebalium	Vulnerable
Striped Water-milfoil	Vulnerable
Hairy tails	Vulnerable
Silky Swainson-pea	Vulnerable
Grey grass-tree	Endangered
Buloke	Endangered
Small Quillwort	Endangered
Shiny Daisy-bush	Endangered
Wedderburn Wattle	Vulnerable
Australian broomrape	Vulnerable
Inland pomaderris	Vulnerable
Late flower flax-lily	Vulnerable
Large rustyhood	Vulnerable
Arching flax lily	Vulnerable
Large-flower amaranth	Vulnerable
Goldfields grevillea	Rare
Bristly greenhood	Rare
Blue Mallee	Rare
Dwarf cassinia	Rare
Club-hair New Holland Daisy	Rare
Streaked Wattle	Rare
Cane spear-grass	Rare
Rayless daisy-bush	Rare
Half bearded spear-grass	Rare
Small-leaf goodenia	Rare
Deane's Wattle	Rare
Short-bristle wallaby grass	Rare
Sikh's whiskers	Rare
Bent-leaf wattle	Rare
Spear grass	Rare

Flora Species	Victorian Advisory List Status
Snowy mint bush	Rare
Giant hop bush	Rare
Diosma rice-flower	Rare
Small flower wallaby grass	Rare
Yellow sea lavender	Rare
Fuzzy new holland daisy	Rare
Common pipewort	Rare
Southern swainson-pea	Rare
Kamarooka Mallee	Rare
Whirrakee Wattle	Rare
Large White Spider Orchid	Rare
Branching groundsell	Rare
Broom bitter pea	Rare
Goldfield boronia	Rare
Club hair New Holland daisy	Rare
Slender tick-trefoil	Poorly known
Plains joyweed	Poorly known
Bluish raspwort	Poorly known
Pale spike-sedge	Poorly known
Trim leek orchid	Poorly known
Deane's wattle	All spp threatened
Rosemary grevillea	All spp threatened
Common sour-bush	All spp threatened

Note: Data presented here (Appendix B) should only be considered indicative only and is subject to detailed on-ground assessment.

Appendix C: Environmental Risk Analysis

Please see attached spread sheet