Barrambie Way Wastewater Pipeline

EP Act Referral Supporting Environmental Review Document

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Water Corporation

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1. Introduction

Water Corporation is proposing to construct a new 12.5 km pressurised wastewater pipeline from the Barrambie Way Sewerage Pumping Station (SPS) in Ellenbrook to the Gnangara Branch Sewer in Wangara. The Barrambie Way Wastewater Pipeline Proposal (hereafter referred to as the 'Proposal') is located 20 km north-east of the Perth CBD, within the City of Swan and the City of Wanneroo (**Figure 1**).

The Development Envelope, which describes the full extent of the area impacted by the Proposal, traverses the Gnangara groundwater system and is within Priority 1 (P1), Priority 2 (P2) and Priority 3 (P3) areas of the Gnangara Underground Water Pollution Control Area (UWPCA). According to Department of Water and Environmental Regulation's (DWER) Water Quality Protection Note (WQPN) #25, pressurised sewerage pipelines are 'incompatible' within a P1 area and 'compatible with conditions' in a P2 area. Water Corporation recognises that P1 areas should be 'managed to ensure there is no degradation of the quality of the drinking water source with the objective of risk avoidance' and seeks to demonstrate that although a portion of the proposed pipeline is through a P1 area, all alternative options pose a greater risk to the public drinking water resource. In addition, through implementing various management strategies, Water Corporation aims to manage risks associated with sewerage infrastructure down to an acceptable level.

The Water Corporation is referring the Proposal to the Environmental Protection Authority (EPA) for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act) due to the potential for significant impacts to the Gnangara UWPCA.

1.1 Purpose and Scope

The purpose of this document is to detail the key characteristics of the Proposal and provide an assessment of the potential impacts that may occur to each of the EPA's environmental factors. This assessment details:

- the EPA environmental factors that may be impacted;
- the EPA policy and guidance that has been considered;
- outcomes of consultation that has been undertaken;
- the condition of the receiving environment;
- the activities that may impact the environment along with proposed management and mitigation actions; and
- an assessment of the potential impacts against the EPA objectives together with assumptions that have been made in the assessment.

This document has been prepared in accordance with the EPA's instructions on how to prepare an Environmental Review Document (ERD) (EPA, 2020a) and is based on project and study information available at the time of writing. This ERD is provided to present additional information to support the referral of the Proposal and to provide information for the EPA to assist in determining whether to assess the Proposal. Water Corporation has consulted with government agencies and key stakeholders to obtain feedback for input into this document to inform the environmental impact assessment of the Proposal.

1.2 Proponent Details

The Proponent for the Proposal is Water Corporation. The Proponent's details are:

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PO Box 1600
Osborne Park DC WA 6916

The key contact in relation to the environmental approvals process for the Proposal is:

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1.3 Environmental Legislation and Approvals.

1.3.1 EP Act

The EP Act is the key legislative tool for environmental protection in Western Australia. The EP Act provides for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement, and management of the environment. Part IV of the EP Act (environmental impact assessment) is administered by the EPA and the Minister for the Environment. The Proposal is being referred under Part IV of the EP Act due to the potential for significant impact to the Gnangara UWPCA, which is covered under the key environmental factor of Inland Waters. The following additional key environmental factors have also been assessed as part of the Proposal:

- Flora and Vegetation
- Terrestrial Fauna
- Terrestrial Environmental Quality

1.3.2 Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)

A proposed action that may have a significant impact on a Matter of National Environmental Significance requires approval from the Commonwealth under the EPBC Act. Matters of National Environmental Significance include threatened species and threatened ecological communities (TEC) that have been listed under the EPBC Act. The Proposal will result in some clearing of the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (Banksia Woodlands TEC) and foraging habitat for both Carnaby's Black Cockatoo and the Forest Red-tailed Black Cockatoo. However, these impacts are not considered significant (as assessed via the relevant EPBC Act guidance documents) and referral under the EPBC Act is not considered to be required.

1.3.3 Gnangara Groundwater System

The Proposal intersects the Gnangara groundwater system (DWER, 2020b). The Gnangara groundwater system covers an area of approximately 2,200 km^2 and is located on the Swan Coastal Plain. The Gnangara groundwater system is a proclaimed groundwater area under section 26B of the *Rights in Water and Irrigation Act 1914*.

To protect groundwater resources, six locations within the metropolitan area have been designated as UWPCAs. UWPCAs are considered a subset of Public Drinking Water Source Areas (PDWSA), a term that encompasses both surface water and ground water sources. The Gnangara groundwater system is covered by the Gnangara UWPCA, which encompasses the Gnangara, Wanneroo and Mirrabooka groundwater areas under the *Metropolitan Water Supply, Sewage and Drainage Act 1909*. UWPCAs are areas where bores have been or will be located to access groundwater for treatment and reticulation to households, businesses, and other users. Three levels of protection have been applied to UWPCAs as follows:

- P1 areas are defined and managed to ensure there is no degradation of the quality of the drinking water source with the objective of *risk avoidance*. P1 areas occur within UWPCA where the existing land uses have low risks to UWPCAs. Consistent with the preventive risk–based framework of Western Australian Government, changes of land use that introduce additional risks are not recommended. P1 areas would typically include Crown land but may also include some private land.

- P2 areas are defined and managed to maintain or improve the quality of the drinking water source with the objective of *risk minimisation*. P2 areas occur within UWPCAs where the land is zoned rural and the risks need to be minimised. Low levels of development consistent with the rural zoning are considered appropriate (generally with conditions) in P2 areas.
- P3 areas are defined and managed to maintain the quality of the drinking water source for as long as possible with the objective of *risk management*. P3 areas occur within UWPCAs where the land is zoned for urban and commercial or light industrial uses. Within P3 areas, drinking water sources need to co-exist with higher intensity land uses compared to P1 and P2 areas. Key elements in the protection of P3 areas include the need for deep sewerage and implementing best management practices (DWER, 2016)

The Development Envelope is located at the southern tip of the Gnangara UWPCA, traversing parts of the Mirrabooka and Wanneroo groundwater areas. Of the 12.5 km total length of the pipeline, 8.5 kms are within a P1 area, 0.5 kms are within a P2 area and 0.5 kms are within the P3 area. The remainder of the pipeline is not within the UWPCA.

1.3.3.1 Strategic Policy: Protecting PDWSAs in Western Australia

This policy is managed by the DWER, and its main purpose is to describe how PDWSAs, including UWPCAs, are managed in Western Australia. It does not introduce new requirements but provides for the continued implementation of Western Australia's existing integrated land use planning and PDWSA protection program.

PDWSA is the collective description for water reserves, catchment areas and UWPCA declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or *Country Areas Water Supply Act 1947*. PDWSAs provide for the management and protection of water used for public drinking supplies.

1.3.3.2 Statement of Planning Policy 2.2 Gnangara Groundwater Protection

This policy is managed by the Department of Planning, Lands and Heritage (DPLH), and the main purpose of this policy is to prevent, control or manage development and land use changes that are likely to cause detrimental effects to groundwater resources. The statement implements the DWER's Strategic Policy – Protecting public drinking water source areas in Western Australia. Table 1 within the policy sets out compatible land uses in P1, P2 and P3 water source protection areas. Table 1 indicates that a sewerage pressure main is incompatible within a P1 area.

1.3.3.3 WQPN #25 – Land use compatibility tables for public drinking water source areas

WQPN #25 is intended to help state and local government protect PDWSAs by preventing, minimising or managing development in PDWSAs, to ensure the ongoing availability of a reliable, safe drinking water supply to consumers at a lower cost. The note provides important guidance to landowners, developers and consultants when preparing development applications for submission to agencies with decision-making responsibilities for land use planning. The compatibility of land uses within PDWSAs is defined in Table 2 of WQPN #25. Pressurised sewerage pipelines are identified as not compatible in P1 areas, compatible with conditions in P2 areas and acceptable in P1 areas.

1.4 Other Approvals

The Proposal will comply with the requirements of other relevant state legislation and regulation. **Table 1-1** provides an overview of the key approvals that are required to implement the Proposal.

Table 1-1: Other Approvals

Type of approval	Legislation regulating the activity
Development Approval from relevant Local Government Authorities (City of Swan and City of Wanneroo).	*Planning and Development Act 2005*
Groundwater abstraction for dewatering during construction and potentially for abstraction of construction water requires 5C and 26D Licences (DWER). This includes the approval of an ASS Dewatering Management Plan.	*Rights in Water and Irrigation Act 1914*
Works within Department of Biodiversity, Conservation and Attractions (DBCA) managed land requires Regulation 4 Authority.	*Conservation and Land Management Act 1984*

1.4.1 Approvals Assessed and Not Required

Several other approvals were assessed and determined as not required for the Proposal. Of note, Water Corporation considers that based on the minimal clearing required and the avoidance of impacts to matters of National Environmental Significance, approval under the EPBC Act is not required. A bed and banks permit is not required as no watercourses are affected, and works approval is not required as the scheme does not have the potential to discharge into the Swan or Canning Rivers.

1.4.1.1 Native Title and Aboriginal Heritage

Water Corporation is committed to the legislative and social requirements to engage and protect matters of Aboriginal heritage significance. Water Corporation's Aboriginal Affairs section conducted archival research within and surrounding the Development Envelope. This research involves an examination of the DPLH Aboriginal Affairs Sites Register, a review of any relevant site files, and a review of any unpublished ethnographic and archaeological reports that relate to the Proposal. A search of the Aboriginal Sites Register was conducted to determine if there were any previously recorded Aboriginal heritage sites that would be affected by the Proposal.

Based on the due diligence assessment, the Proposal is in an area that has been previously disturbed and will have no impact to any Aboriginal heritage sites; however, should any human skeletal or cultural material be discovered whilst undertaking the project there is an obligation under section 15 of the *Aboriginal Heritage Act 1972* to record and lodge site information with the DPLH. All works must cease immediately, and additional care shall be taken at the scene.

Furthermore, Water Corporation's Aboriginal Affairs section has assessed the impact of the Proposal on the land tenure where native title rights and interests may be affected and have determined that native title interests will not be impacted.

Water corporation will conduct additional research prior to construction to ensure this information is still valid.

2. Proposal Description

The Ellenbrook Sewer District (SD) is located within the City of Swan and includes the suburbs of Ellenbrook, Aveley and The Vines as well as and parts of Henley Brook, Belhus and Upper Swan. The Barrambie Way SPS currently transfers all wastewater from Ellenbrook SD south to the Balga Branch Sewer in Balga, before transferring wastewater west and then north to the Wanneroo Main Sewer and, ultimately, Beenyup Wastewater Treatment Plant (WWTP). This arrangement was suitable to cater for medium term growth by using existing sewerage infrastructure. However, due to growth in Perth's Northern suburbs, it is no longer feasible to convey wastewater along this route, and an alternative disposal method is required (Water Corporation, 2018a).

To cater for significant and sustained population growth in Ellenbrook and surrounding areas, Water Corporation is proposing to construct a new pressurised wastewater pipeline along Gnangara Road from the Barrambie Way SPS in Ellenbrook to the Gnangara Branch Sewer in Wangara (**Figure 1**). The proposed pipeline is 12.5 km in length and will provide for population growth in Perth's north eastern suburbs.

The Proposal is summarised in **Table 2-1**. The location and physical and operational elements of the Proposal are provided in **Table 2-2**.

Table 2-1: Summary of the Proposal

Proposal Title	Barrambie Way Wastewater Pipeline
Proponent Name	Water Corporation
Short Description	Construction and operation of 12.5 km sewer pressure main from the Barrambie Way Sewerage Pump Station to the Gnangara Branch Sewer

Table 2-2: Location and Proposed Extent of Physical and Operational Elements

Element	Location	Proposed Extent

Construction	The Development Envelope (**Figure 1**)	Clearing and disturbance of no more than 30 ha within the Development Envelope including:
		▪ No more than 0.3 ha of native vegetation, of which 0.06 ha has been mapped as Banksia Woodlands of the Swan Coastal Plain TEC/PEC in Very Good (0.04 ha) or Excellent (0.02 ha) condition
		▪ No more than 0.43 ha of habitat for Carnaby's Black Cockatoo of which:
		  ▪ 0.06 ha is Very High Quality;
		  ▪ 0.14 ha is Quality; and
		  ▪ 0.2 ha is Low Quality
		▪ No more than 0.1 ha of habitat for the Forest Red-Tailed Black Cockatoo of which:
		  ▪ 0.06 ha id Very High Quality; and
		  ▪ 0.04 ha is Low Quality
		▪ 2 potential breeding trees for Black Cockatoos (with no suitable hollows)
		▪ No more than 0.25 ha of native vegetation in Good to Excellent condition within Bush Forever site 196.

Element	Location	Proposed Extent
Construction dewatering	Development Envelope (**Figure 1**)	As approved under the 5C RIWI Act licence or exemption.

2.1 Wastewater Characteristics

The proposed wastewater pipeline will convey domestic wastewater. Water Corporation enforces strict controls over the discharge of wastes into the wastewater system from commercial premises.

2.2 Design Requirements

The Proposal has been specifically designed in consultation with key stakeholders to reduce the risk of contamination to the receiving environment. The key design features are the use of smaller diameter, duel pipelines, fully welded PE pipe materials, remotely controllable valves, and the construction of additional emergency overflow storage. These design features are explained in detail in Section 3.3.

2.3 Construction Activities

Open cut excavation (trenching) will be used for the majority of the pipeline, with exceptions at road crossings including Gnangara Road and Alexander Drive, which will use trenchless construction methods (tunnelling) to reduce the construction impact to major roads.

Standard trenching machinery will be used for most of the construction. This will include trenchers, excavators and pipe layers with padding machines to backfill the trench. The presence of rock in some locations will likely require the use of rock breakers or rock saws.

As portions of the wastewater pipeline are completed, they will be pressure tested to confirm pipe sections have been adequately connected and sealed and that no leaks are present at the joints.

Most construction activities will be contained within the 15-metre-wide construction corridor. Infiltration ponds are likely to extend beyond this, depending on the size required to manage dewatering volumes. The exact locations of infiltration ponds are yet to be confirmed and will depend on the dewatering requirements. However, they will be located in previously cleared areas and managed according to the approval requirements.

2.4 Maintenance Activities

The pipeline is designed such that it can be monitored centrally to detect leaks through changes in flow. Remotely controllable valves can be closed in the event of a change in flow that indicates a leak. Water Corporation inspects and operates valves frequently to ensure the integrity of the system. The majority of the pipeline is within cleared areas; therefore, there will be no disturbance to the environment through maintenance activities.

3. Alternatives Analysis and Proposal Justification

The main driver for the Proposal is urban development pressure, particularly population growth in Ellenbrook and surrounding suburbs. Urban residential development of Ellenbrook commenced in 1995, and it continues to be a fast-growing area of Perth. The population of Ellenbrook has grown from approximately 22,000 in 2016, to 48,000 in 2019, and is forecast to be over 70,000 by 2036. The average daily flow of wastewater to the Barrambie Way SPS has more than doubled since 2010, from 40 Litres per second, to over 100 Litres per second (Water Corporation, 2019). To meet the increasing demand on the Barrambie Way SPS from recent and expected future population growth within the Ellenbrook SD, the pumping rate and conveyance system at Barrambie Way SPS must be significantly upgraded (Water Corporation, 2018a). The existing infrastructure does not have capacity for this increase in pumping rate and additional wastewater disposal capacity is required.

3.1 Alternative Options Considered

To identify the preferred option to meet the increased demand for wastewater conveyance at the Barrambie Way SPS, several alternative methods were identified. These alternatives were to 'do nothing', construct an onsite WWTP in Ellenbrook, tankering of excess wastewater offsite or construction of a new wastewater pipeline. These options are further discussed below.

Do Nothing

Currently, the Barrambie Way SPS pumps to the Balga Avenue Branch Sewer via a 500 mm diameter wastewater pipeline running south along Drumpellier Drive, Starflower Road and Marshall Road to the Balga Avenue Branch Sewer. Recent hydraulic modelling confirms that the Balga Avenue Branch Sewer does not have capacity for the required pumping rate increase at Barrambie Way SPS.

Under the *Water Services Act 2012*, the Water Corporation is required to provide water and wastewater services and cannot, therefore, refuse to accept the additional wastewater generated from population and housing growth in Ellenbrook and West Swan. Without a new method to dispose the wastewater received at the Barrambie Way SPS, the raw sewage will either flood the Barrambie Way SPS site or the Balga Avenue Branch Sewer. Raw sewage overflowing into the environment at either location is unacceptable from an environmental and community perspective; therefore, the 'do nothing' alternative was discounted.

On-site WWTP

An on-site WWTP requires large areas of land for treatment and storage facilities and a designated buffer zone from the surrounding residential area, which is not available in the Ellenbrook area. In addition, the considerable time needed for this alternative to progress through the design, approval, land acquisition and construction phases would further preclude it from consideration. The costs for this option are considerable and do not eliminate the need to dispose of treated wastewater. The on-site treatment and disposal alternative was, therefore, not considered further.

Tankering

Tankering involves using water trucks to collect the wastewater from its source and dispose it at a suitable WWTP or SPS. Up to 20 Litres per second of disposal can be achieved using this method with several trucks taking wastewater from a single collection point. To manage the inflow at Barrambie Way SPS, there would need to be several hundred wastewater carting truck movements daily along Gnangara Road. This alternative was discounted on the basis of public acceptability, practicality, cost and safety.

New Wastewater Pipeline

Building a pipeline to convey the wastewater from Barrambie Way SPS to the Gnangara Branch Sewer was identified as the only feasible, practical and cost-effective alternative.

With the construction of a new wastewater pipeline identified as the only feasible option, attention was given to determining the most appropriate pipeline alignment, given the presence of environmentally sensitive areas surrounding the Barrambie Way SPS.

3.2 Pipeline Route Alternatives

Water Corporation undertook an extensive review of pipeline route options as part of the Barrambie Way Pipeline Concept Design Report (Water Corporation, 2018a). Six alternative pipeline routes (**Figure 2**) between the Barrambie Way SPS and the Gnangara Branch Sewer were evaluated for environmental impacts, hydraulic viability, safety and accessibility, social and public impacts and cost. The route detail, advantages and disadvantages of each alternative are summarised below. All options identified are located within existing road reserves to avoid direct impacts on private landowners.

3.2.1 Option 1 – West Along Gnangara Road

Option 1, shown in **Figure 2a**, is the shortest and most direct route. With a total pipeline length of 12.5km.

Environmental Impacts

The alignment runs directly through the Gnangara UWPCA, and pressurised wastewater pipelines are classified as 'incompatible' within P1 areas as stated in SPP 2.2 and WQPN #25. Water quality risks associated with a wastewater leak to the P1 area was assessed by completing a detailed risk assessment. Due to the hydrogeological characteristics in the vicinity of the SMP, the superficial aquifer was determined to have 'moderate' vulnerability and the residual likelihood of a wastewater leak into the aquifer was determined as 'low'. Details of the investigation are provided in *IWSS Mirrabooka Wellfield Vulnerability and Risk Assessment of Wastewater Pressure Main, July 2020*, and *Risk to M200 Series Production Wells, July 2020* (**Appendix D**).

The proposed route will intersect existing Water Corporation production wells and associated wellhead protection zones (M300, M310, M320, M330, M340 and M350) with a combined allocation of 50ML per year until 2028. After 2028 abstraction from these bores is expected to cease. Option1 although through the P1 area, has the lowest impact of all options on groundwater as a drinking water resource.

Further detail is provided in Section 6 to explain why this option has the lowest impact on drinking water quality.

A Preliminary Environmental Impact Assessment (PEIA) was undertaken by AECOM (2018a) along the routes of Options 1, 2 and 3 and found that Option 1 has the least environmental constraints. Subsequent environmental assessments have confirmed that Option 1 has the smallest area of Black Cockatoo habitat, native vegetation and Banksia Woodlands TEC within the corridor when compared with Options 2 and 3.

Hydraulic Viability

With a significantly shorter pipeline length than other options, Option 1 has the lowest detention time of wastewater in the pipeline. A longer detention time increases the sulphide generation in wastewater, which causes the wastewater to become more acidic, corrosive and odorous.

Safety and Accessibility

Gnangara Road has a wide carriage way compared to other alignments, which allows separation of the pipeline from other current and future services, thereby reducing the likelihood of third-party damage to the pipeline. The area is mostly clear and accessible for construction and maintenance of the pipeline. The wide corridor also allows room for safe access and maintenance for operational personnel.

The duration of construction for Option 1 will be significantly shorter than other options, which reduces disruption to these stakeholders is less than other alternatives.

Social and Public Impacts

There are very few businesses or residents that will be affected under Option 1 compared with other alternatives.

Cost

The preliminary capital cost estimation for Option 1 is $19 million, which is the lowest capital cost among all alternatives.

3.2.2 Option 2 – Skirting the P1 UWPCA

Option 2, shown in **Figure 2b**, runs south along Starflower Road, west on Marshall Road, and north on Alexander Drive. The route is 26.1 km in length, 13.5 km longer than Option 1.

Environmental Impacts

The intention of Option 2 was to avoid the P1 UWPCA as much as possible while still maintaining a feasible alignment. This route avoids the P1 area for most of its length but is along the western boundary of the P1 area at Alexander Drive and Gnangara Road and intersects the edge of the P1 area at several locations due to the alignment of the road.

Although mostly avoiding the P1 area, Option 2 poses a greater risk to the UWPCA due to the longer pipeline and intersects a greater number of wells when compared to Option 1. The route falls within the wellhead protection zone of the M200 bores, which have a significantly higher groundwater allocation when compared to Option 1. The total abstraction from the M200 bores that may be impacted by this Option and is estimated to be 870 - 1,180 ML per year prior to 2028, and 1,030 ML post 2028.

The PEIA (AECOM, 2018a) identified that this option has a significantly greater environmental impact than Option 1. The assessment identified that 185 potential breeding trees would need to be cleared of which nine had suitable hollows, compared to the two potential breeding trees cleared for Option 1. It also had the greatest amount of native vegetation within the corridor (25.14 ha), Banksia Woodlands TEC (7.59 ha) and foraging habitat for Carnaby's Black Cockatoo (32.95 ha).

Hydraulic Viability

Option 2 is significantly longer than Option 1, resulting in a longer detention time that will increase the acidity and corrosiveness of the wastewater.

Safety and Accessibility

There is limited available space at several points along Option 2, with existing services along the alignment and commercial and residential areas. This will complicate construction and maintenance of the pipeline. The roads are narrow and, in some locations, heavily congested with other services compared to Gnangara Road, and this increases the risk of a third party (for example, other service providers) damaging the pipeline during excavations. There are several inaccessible areas for location and construction of the pipeline.

Option 2 has limited opportunities to locate operational or maintenance infrastructure to allow ease of access for future operational, maintenance or emergency response situations.

Social and Public Impacts

Option 2 follows Alexander Drive and Marshall Road, which have well established commercial and residential urban developments. Constructing a new large diameter pipeline through these areas will create substantial disturbance to the community.

Significant disruption is expected to commercial businesses and local residents if this alternative is pursued. Disruption to public transport will occur as the roads are public transport corridors serving Ellenbrook. The duration of construction works that will cause disruption is significantly greater compared with Option 1.

Cost

The preliminary capital cost estimation for Option 2 is $40 million.

3.2.3 Option 3 – Skirting the P1 UWPCA and Avoiding Future Development

Option 3, shown in **Figure 2b**, was developed to avoid the area identified for future urban development and to reduce the disturbance to the local community. With a more greenfield site, the construction of the pipeline is expected to be easier than Option 2. This option avoids the intersection of Starflower Road and Marshall Road by going through the less developed area. The route is 24.9 km, 12.3 km longer than Option 1.

Environmental Impacts

The intention of Option 3, as in Option 2 was to avoid the P1 UWPCA as much as possible while still maintaining a feasible alignment. This route also avoids the P1 area for most of its length but intersects the edge of the P1 area at several locations due to the alignment of the road.

Option 3 was assessed as posing a greater risk to the UWPCA when compared to Option 1. Option 3 pipeline is considerably longer increasing the likelihood of a wastewater leak. This option also intersects the wellhead protection zone of the M200 bores which have a significantly higher groundwater allocation than the M300 bores affected by Option 1.

As shown in the PEIA (AECOM,2018b), Option 3 has an environmental impact similar to Option 2, with 23.74 ha of native vegetation within the corridor and 331 potential breeding trees for Black Cockatoos, of which nine have suitable hollows.

Hydraulic Viability

Option 3 is significantly longer than Option 1 and results in a longer wastewater detention.

Safety and Accessibility

Options 2 and 3 share the same disadvantages of lack of accessibility, a tight construction corridor and issues with existing services

Social and Public Impacts

As in Option 2, significant disruption is expected to commercial businesses and local residents if this alternative is pursued.

Cost

The preliminary capital cost estimation for Option 3 is similar to Option 2 at $40 million.

3.2.4 Options 4, 5 and 6 – Avoid the P1 UWPCA

Options 4, 5 and 6 shown in **Figure 2c,** were developed in an attempt to avoid the P1 UWPCA entirely. The pipeline routes are longer than the other options at approximately 26 km. The routes follow a similar alignment to Option 3 but deviate to avoid the P1 UWPCA. Each route was assessed to determine if a hydraulically viable option existed to avoid crossing the P1 UWPCA.

Environmental Impacts

The intention of Options 4, 5 and 6 was to avoid the P1 UWPCA entirely; however, it was determined that all options affect similarly sensitive environmental areas and, as such, the environmental impacts are considered to be the same as Option 3. The intent of water source protection cannot be met with these options due to the proximity of the M200 bores.

Hydraulic Viability

The natural surface level along Mirrabooka Avenue is significantly higher than the land to the east. As a result, Options 4, 5 and 6 will require a pumping head that cannot be delivered by commercially available sewerage pumps. It is not considered to be hydraulically viable, unless an additional booster pump station and gravity sewer are constructed, which adds considerable cost and complexity.

Safety and Accessibility

Options 4, 5 and 6 share the same disadvantages as Option 3 of lack of accessibility, a tight construction corridor and issues with existing services

Social and Public Impacts

As in Option 3, significant disruption is expected to commercial businesses and local residents if these alternatives are pursued.

Cost

The preliminary capital cost estimation for all three options is $60 million.

3.3 Minimising the Risk of Option 1

The assessment of all six options has identified that Option 1, while crossing the P1 UWPCA, is the preferred option for all aspects of the assessment. An assessment was undertaken of the existing wastewater pipeline from the Barrambie Way SPS to the Balga Branch Sewer, constructed in 1999, which passes through the P2 and P3 areas of the Gnangara UWPCA. This pipeline is a 500 mm diameter mild steel pipeline with flexible rubber joints, which is a standard pipeline design. A review of the compliance assessment reports prepared for the existing pipeline shows that this pipeline has not had any leaks that were a result of failure of the pipeline. The pipeline was, however, damaged in 2006 during works undertaken by a third party. Monitoring of bores in the vicinity of the damage has been undertaken since 2006.

It was determined that a pipeline design would need to be considerably more robust to meet drinking water quality objectives in a P1 UWPCA. The final pipeline design option was developed in consultation with external agencies and internal Water Corporation water quality personnel to reduce the risk to the P1 area from a potential leak of wastewater from the pipeline.

The recommended design has a range of engineering features that are above a Business as Usual (BAU) pipeline design. **Table 3-1** shows the comparison between a BAU pipeline and the preferred design option. The significance of each option is explained below the table.

Table 3-1 Preferred Pipeline Design Versus Business as Usual Pipeline Design

Engineering / Administrative Features	BAU Pipeline	Recommended Pipeline Design
Pipeline Configuration	Single pipeline	Dual pipelines through the P1 area, with interconnections
Pressure Rating	PN12.5 (1250 kPa), flexible joints	PN16 (1600 kPa), welded joints
Isolation Valves	Not normally used	Remotely operated isolation valves at a maximum of 2 km intervals
Leak Detection Measures	No permanent leak detection	Various leak detection measures: ▪ Pump flow rate monitoring ▪ Pump power monitoring ▪ Acoustic leak surveys ▪ Visual inspection
Contingency Measures	No permanent back up	The existing DN500 wastewater pipeline can be used as an additional contingency Newly constructed emergency overflow storage tank at Barrambie Way SPS
Warning Signs	Marker posts for identification of the asset	Warning signs to be used for the pipelines within P1 area
Administrative risk management processes	Adhere to the Corporation's Catchment Checklist for Clearance to Work Permits.	Adhere to the Corporation's Clearance to Work within a PDWSA And Bores near construction site will not be operated during construction activities.

Pipeline Configuration

A duel-pipeline design allows for operational flexibility, which will significantly improve the response to any wastewater leak in the P1 UWPCA. A single pipeline from Ellenbrook would be a critical asset that would be difficult to shut down; however, duel pipelines allow wastewater to continue flowing through the non-leaking section of pipeline while the problem area is shut down, isolated and repaired.

Pressure Rating

Wastewater pipelines are usually rated to ensure they will not leak when exposed to the maximum possible pressure that can be achieved in the system. Increasing the pressure rating for this pipeline results in a substantial increase in the wall thickness of the PE pipe. Furthermore, each pipe section is welded to the next, eliminating the possibility of a leak from the joints. The combination of a high-pressure rating and a fully welded pipeline results in a system that is unlikely to leak. The pipeline will be tested at the time of construction with potable water to ensure the system is completely sealed.

Isolation Valves

Standard wastewater pipelines are not constructed with isolation valves. This pipeline will have remotely controllable isolation valves every 2km in the P1 UWPCA, which significantly improves the ability to respond to a leak. In the event that a leak is detected, the leaking section can be isolated from Water Corporation's Operations

Centre while the remainder of the system continues to operate normally. The operations team are then dispatched to the site to investigate the potential leak.

Leak Detection Measures

The visibility of the new pipeline to Water Corporation's Operations Centre allows the ability to respond to changes in flow that may indicate a leak. The Barrambie Way pump station will be monitored at all times for anomalies in flow patterns, pumping rates and power use. Frequent visual inspections will also be implemented in the maintenance program for the pipeline, along with regular acoustic leak surveys.

Contingency Measures

This scheme has been designed with robust contingency measures to ensure operation of the wastewater system can continue if the new pipeline is to be isolated to investigate or repair a leak. Water Corporation has recently constructed a 3 Million Litre emergency overflow tank at Barrambie Way SPS, which allows the SPS a shutdown time of over 8 hours. This contingency allows ample time for the system to be shut down and a leak to be investigated. The pipeline also has remotely controllable isolation valves as described above to allow for additional time to isolate and repair a leak in the system. Finally, the existing Barrambie Way pipeline will remain, as a contingency to run the SPS at a lower rate if additional time is needed to respond to a leak.

Warning Signs

Throughout the P1 UWPCA, warning signs, similar to those used for high pressure gas pipelines, will be used to alert third parties working in the area of a buried wastewater pipeline. This is a higher standard than Water Corporations pipeline markers.

Administrative Risk Management Processes

All construction work with a PDWSA must comply with the Corporation's Catchment Checklist for Clearance to Work Permits. This work instruction provides guidance on drinking water source protection to Water Corporation staff and contractors when works are to be undertaken in a drinking water catchment area. Adhering to this work instruction during the planning, design and implementation phases of the work will reduce the potential risk of adverse effects on drinking water quality.

Bores near construction site will not be operated during construction activities. Bores will only be brought into production once the requirements in the Corporation's Bringing Existing Source Back Online Checklist are met. Avoiding operation during periods of higher risk will prevent drawdown of potential contaminants into groundwater.

Catchment Checklist for Clearance to Work Permits and Bringing Existing Source Back Online Checklist are provided in **Appendix E**.

4. Local and Regional Context

4.1 Overview and Socio-Economic Environment

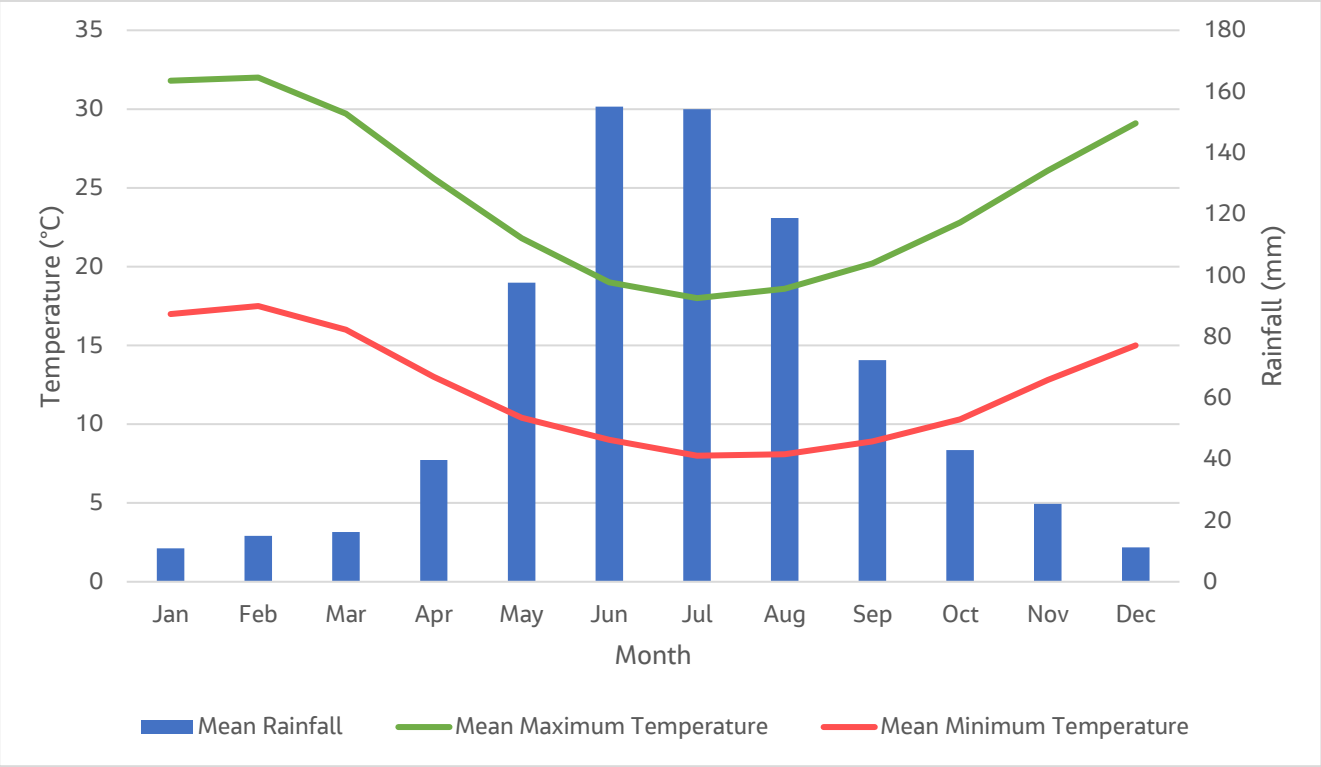
The Proposal is located within the City of Swan and the City of Wanneroo, approximately 6 km from Ellenbrook and approximately 20 km from the Perth CBD, Western Australia. In 2017, Ellenbrook had a population of 41,382, increasing from 22,681 in 2016 (ABS, 2018).

4.2 Tenure and Land Use

The Proposal largely follows Gnangara Road, which is a major traffic route. Land uses along the pipeline route include rural residential, market gardens, turf production, horse agistment, telecommunications, nature conservation and a petrol station (Water Corporation, 2018a). Tenure along the pipeline route is a mix of freehold and Crown land.

4.3 Climate

The Perth metropolitan area, within which the City of Swan and City of Wanneroo sit, experiences a Mediterranean climate with warm to hot dry summers and mild to cool wet winters. Rainfall mainly occurs during winter months, with the possibility of some summer storms. Climate data from the Bureau of Meteorology (BoM) weather station at the Perth Airport (Station Number 009021), which is approximately 15 km from the Development Envelope, shows that the mean maximum monthly temperature can vary between 18°C (July) and 32°C (February). The mean minimum temperature can also vary between 8°C (July) and 17.5°C (February) (BoM, 2020). Perth Airport experiences annual rainfall of 762.1 mm. It averages from 10.9 mm in January, to 154.2 mm in July (BoM, 2020; Graph 4-1).



Graph 4-1: Climate Data recorded at the Perth Airport BoM Bureau Station (1944-2020) (BoM, 2020)

4.3.1 Bioregional Context

The Development Envelope is within the Perth subregion of the Swan Coastal Plain Bioregion (Interim Biogeographic Regionalisation for Australia (IBRA) 7.0; DAWE 2020a); as shown in **Figure 3.** The key features of this Bioregion are as follows (Environment Australia, 2000):

- Low lying coastal plain, mainly covered with woodlands.
- It is dominated by Banksia or Tuart on sandy soils, *Allocasuarina obesa* on outwash plains, and paperbark in swampy areas.
- In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland.
- The outwash plains, once dominated by *A. obesa*-marri woodlands and *Melaleuca* shrublands, are extensive only in the south.

The Perth subregion is comprised of a narrow belt less than 30 km wide of aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age and reaches from approximately Jurien Bay in the north to Dunsborough in the south (Gibson et al., 1994). A complex series of seasonal freshwater wetlands, alluvial river flats, coastal limestone and several offshore islands are included in the bioregion. Younger sandy areas and limestone are dominated by heath and/or tuart woodlands, while Banksia and jarrah-Banksia woodlands are found on the older dune systems. The Perth subregion contains rare features including Holocene dunes and wetlands and many rare and threatened species and ecological communities (Mitchell et al., 2002).

4.3.2 Landforms and Land Systems

The sediments found throughout the Development Envelope comprise of Pliocene-Quaternary age and are about 50-60 m thick. These sediments, the Superficial formations, unconformably overlie Cretaceous sedimentary rocks of the Perth (Sedimentary) Basin (GHD, 1997).

The combination of relatively high rainfall, sandy soils and flat topography has resulted in the occurrence of large renewable groundwater resources in the Superficial formations, known as the Superficial aquifer. Lakes and wetlands are connected to the unconfined aquifer within the Bassendean Sands. These sands occur to depths in excess of 40 m (GHD, 1997).

The dominant soil type of the Development Envelope is the Bassendean Sand formation, which consists of basal conglomerate overlain by dune quartz sand with heavy mineral concentrations, as mapped by the Australian Soil Atlas (National Resource Information Centre, 1991). The majority of the Development Envelope occurs within soils that can be described as subdued dune-swale terrain with the chief soils being leached sands.

4.3.3 Hydrology

The Development Envelope is located partly in an area that is designated as a P1 UWPCA and overlaps the Gnangara groundwater system, also known as the Gnangara Water Mound or the unconfined Superficial aquifer. The aquifer stretches from Gingin to the Swan River and comprises of Quaternary-Tertiary sediments of the Swan Coastal Plain (DWER, 2020a).

A study by Galt Geotechnics (2019) stated that the Perth Groundwater Atlas (1997) showed the historical maximum groundwater level to be around Reduced Level (RL) 46 m Australian Height Datum (AHD) in the middle portion of the Development Envelope, falling to RL 44 m AHD in the west and RL 41 m AHD in the east. The historical maximum groundwater elevation is, therefore, within 1 m of the surface over most of the Development Envelope. They noted that the geomorphic wetlands ('Palusplain' and 'Dampland') are present in the eastern and western portions of the Development Envelope. The study also concluded that groundwater test results indicated that pH values were below the recommended range of 6.5 to 8.5 at most locations, while concentrations of total aluminium (1 location), total iron (11 locations) and dissolved iron (11 locations) exceeded the adopted criteria, suggesting historical oxidation of Acid Sulphate Soils (ASS) and subsequent

metal mobilisation has occurred along the Development Envelope (Galt Geotechnics, 2019). Additional detail is provided in Sections 6.5 and 6.6.

5. Stakeholder Engagement

Water Corporation has a dedicated community engagement team that has extensively consulted with key stakeholders throughout the development of the Proposal. Of note, the section of the wastewater pipeline within the P1 area has been designed in consultation with DWER, and in-principal support for the Proposal has been provided via email to Water Corporation by the DWER's Water Source Protection Planning Section (**Appendix A**).

Consultation with stakeholders for the Proposal has been ongoing since 2017, with key meetings with major stakeholders including state government agencies, local government authorities, landowners and occupiers. Ongoing engagement is guided by the Community Engagement (CE) Strategy – a live document that is updated as the project progresses.

5.1 Stakeholder Identification

Stakeholder engagement commenced early in the planning process with a focus on undertaking a thorough analysis of the proposed delivery options, and collaboration with government agencies to identify and agree the preferred route. Water Corporation has sought to engage on major issues through in-person briefings where possible, with written updates provided to support a timely flow of information to stakeholders. A summary of the key stakeholders identified for the Proposal is provided below in **Table 5-1**.

Further consultation will be undertaken with stakeholders when investigative work has been completed and the design is available for presentation and discussion.

Table 5-1: Key Stakeholders Identified for the Barrambie Way Wastewater Pipeline Proposal

Stakeholder	Relevance to Project
State Government Agencies ▪ DWER, EPA, Water and Source Protection Planning ▪ DPLH ▪ Western Australian Planning Commission (WAPC) ▪ Main Roads Western Australia ▪ DBCA ▪ Public Transport Authority - METRONET project	▪ Approvals ▪ Endorsement ▪ Planning information
Local Governments ▪ City of Wanneroo ▪ City of Swan	▪ Collaboration around design ▪ Community impact communications ▪ Access and construction impacts
Community members ▪ Road users ▪ Business owners ▪ Residents	▪ Access and construction impacts ▪ Easements required for land along the proposed pipeline route
Environmental groups	▪ Update regarding environmental footprint

5.2 Stakeholder Engagement to Date

DWER – Water Source Protection Planning Branch and Infrastructure Assessment Branch

Face-to-face briefings and email updates have been provided to the DWER, particularly regarding works within the P1 UWPCA and options for reducing the risk to the drinking water resource.

Main Roads Western Australia

Face-to-face meetings, emails and phone calls have informed the alignment of the proposed infrastructure, as well as aspects of the design.

Local Government

Face-to-face meetings, emails and phone calls have been held with the City of Swan and City of Wanneroo, which has informed the decision regarding potential alignment options.

Landowners

Water Corporation has liaised with the WAPC, DBCA and Department of Health regarding their land. Water Corporation has plans to engage with landowners along Gnangara Road regarding easements for the pipeline route once this is confirmed and the design available for discussions.

5.3 Outcomes

Early consultation has indicated that with sufficient risk assessment and mitigation, the preferred option of a new wastewater pipeline along Gnangara Road would meet the requirements of affected stakeholders.

A summary of the stakeholder engagement undertaken to date, and associated outcomes, is detailed in **Table 5-2**.

Table 5-2: Stakeholder Consultation Undertaken for the Barrambie Way Wastewater Pipeline Proposal

Stakeholder	Date	Consultation Type	Consultation Topic/Outcome
DWER	21/02/2019	Water Corporation face-to face meeting with Stephen Watson from Water Source Protection Branch.	DWER recommended Water Corporation provide information regarding the risks, by using the water quality risk process to demonstrate low risk.
DWER-EPA	13/03/2019	Water Corporation face-to-face meeting with Hans Jacob from Infrastructure Assessment Branch.	An overview of the project was provided. Hans Jacob confirmed it would require EPA referral. Items for Water Corporation to note: ▪ Undertake a risk assessment ▪ Consider terrestrial impacts ▪ Ensure controls for water quality are feasible/doable ▪ Consider the risk over time
City of Wanneroo City of Swan Main Roads	05/07/2019	Face-to-face meeting between Water Corporation and key stakeholders.	City of Wanneroo and City of Swan did not have any major objections to the pipeline route. They advised they would need to approve all Traffic Management Plans for any work being undertaken. City of Swan and Main Roads confirmed that Gnangara Road in City of Swan will be handed over to Main Roads in the near future. Main Roads confirmed that Gnangara Road will have a 'control of access' once they take over. Main Roads explained that 'control of access' means that utilities services are generally not allowed to be constructed in the road verge or the middle of the road.
DWER	02/04/2020	Face-to-face presentation by Water Corporation Water Quality to DWER.	Water Corporation presentation to DWER to provide background on the project drivers and options explored.
DWER	08/05/2020	Face-to-face presentation by Water Corporation Water Quality to DWER Source Protection.	Advice from DWER's EPA Services Unit is that the Proposal must have DWER (Source Protection) approval of the proposed pipeline route through the UWPCA.
DWER	18/06/2020	Email to Stephen Watson of DWER Water.	Technical advice – Risk to M200 Series Production Wells report sent to DWER.

Stakeholder	Date	Consultation Type	Consultation Topic/Outcome
DWER	04/09/2020	Email from Stephen Watson of DWER Water Source Protection Planning.	Advised DWER Water Source Protection Planning has considered the Proposal in meetings with Water Corporation and from the data provided. DWER provided 'in principle' support of the Proposal and its progress to the EPA.
Main Roads City of Swan	05/10/2020	Email to Luke Scata at City of Swan.	City of Swan advised they are retaining ownership of Gnangara Road west of Tonkin Hwy and that Main Roads are only taking over maintenance of the road.
DWER-EPA	18/02/2021	Face to face meeting with Water Source Protection Planning and Infrastructure Assessment Branches.	Water Corporation presented the Proposal and key features in a pre-referral meeting. DWER noted that the referral document must clearly outline: • A detailed options analysis. • Aboriginal Heritage consideration. • Greenhouse Gas – Scope 2 and Scope 3, include estimation and demonstrate the project does not trigger these requirements. • Offsets – if these are proposed. • Ensure the referral document is clearly explained, detailed, and provides examples where relevant. • Include/consider pathogens and PFAS. • Consider the consequence of a wastewater spill and what it would mean in the area. • Detail internal processes and actual measures. • Management of chemical storage. • Proximity to wellhead protection zones and how this will be managed. • Mitigation measures.

6. Environmental Principles and Factors

6.1 Environmental Principles

The five core principles of environmental protection are embedded in the EP Act. These principles align with the principles of Ecologically Sustainable Development outlined in Section 3A of the EPBC Act. **Table 6-1** describes how each of the five principles of the EP Act has been applied to the Proposal.

Table 6-1: Principles of Environmental Protection

Principle	Consideration of Principle in the Proposal
The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decision should be guided by: a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and b) an assessment of the risk-weighted consequences of various options.	A wide range of comprehensive desktop and field studies were undertaken within the Development Envelop to assess the impact of the Proposal. Studies included: ▪ Flora and vegetation; ▪ Terrestrial fauna; and ▪ Geotechnical Impacts have been identified and described under each key environmental factor in the following sections. Information gathered during these studies will reduce the uncertainty surrounding prediction of impacts for the assessment. The alignment for the wastewater pipeline has been located in previously cleared areas to minimise the need to clear native vegetation. To reduce the risk to the drinking water resource, where the alignment traverses through the P1 area the design includes measures to reduce the potential for leaks from the wastewater pipeline. These measures include: ▪ higher than usual pressure rating, ▪ dual pipeline ▪ leak detection ▪ remotely operated valves to isolate sections of the pipeline ▪ 3 ML emergency storage outside the UWPCA ▪ M300 superficial bores will not be operated during construction or commissioning of the wastewater pipeline, and the bores are unlikely to be used post 2028. An alternate, longer route around the P1 area has been considered (Option 2), however this route, while not in a P1 area, is still within wellhead protection zones of bores with a greater allocation.
The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The Proposal will ensure the health, diversity and productivity of the environment is maintained through minimising clearing of native vegetation and fauna habitat and design of the pipeline to avoid contamination of the drinking water resource.

Principle	Consideration of Principle in the Proposal
The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	The ultimate alignment for the wastewater pipeline was selected in order to minimise clearing of native vegetation and fauna habitat, thereby conserving the biological diversity and ecological integrity of the surrounding area.
Principles relating to improved valuation, pricing and incentive mechanisms a) Environmental factors should be included in the valuation of assets and services. b) The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. d) Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.	Environmental factors were considered when evaluating options. Water Corporation has assessed the environmental constraints of different options to determine the best option for the viability of the wastewater network. Measures to avoid and minimise potential environmental impacts, along with the costs associated with these, have been considered in the design of the Proposal. The proposed design and construction method for the wastewater pipeline through the P1 area is more expensive than standard, business as usual design and methods.
The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Waste will be minimised during construction by adopting the hierarchy of waste controls - avoid, minimise, reuse, recycle and safe disposal. The Proposal aims to minimise the risk of leaks from the wastewater pipeline by providing sufficient capacity for predicted future demand and including design measures such as a higher than usual pressure rating of the pipe, leak detection and remotely operated valves to isolate sections of the pipeline.

6.2 Identification of Key Environmental Factors

Environmental factors are those parts of the environment that may be impacted by a proposal (EPA, 2020b). The EPA has 14 environmental factors, organised into five themes (Sea, Land, Water, Air and People), which allow for a systematic approach to organising environmental information for the purpose of impact assessment. Each of the 14 environmental factors has an associated objective which is used to determine whether the potential environmental impacts of a proposal or scheme may be significant. The EPA environmental factors and objectives, and their relevance to the project, are summarised in **Table 6-2**.

The Key Environmental Factors for this proposal are Flora and Vegetation, Terrestrial Environmental Quality, Terrestrial Fauna and Inland Waters. Discussion of potential impacts to Social Surroundings, namely from noise and dust emissions, has been included as an 'Other Environmental Factor' due to the expected interest within the local community in the management of these impacts.

Table 6-2: EPA Environmental Factors (EPA, 2020b) and their Relevance to the Proposal

Theme	Factor	Objective	Relevance to Proposal	Key Environmental Factor?
Sea	Benthic Communities and Habitats	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	The Proposal is not located in or near the marine environment.	×
	Coastal Processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.		
	Marine Environmental Quality	To maintain the quality of water, sediment and biota so that environmental values are protected.		
	Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.		
Land	Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	The Proposal requires native vegetation clearing (no more than 0.3 ha).	✓
	Landforms	To maintain the variety and integrity of significant physical landforms so that environmental values are protected.	The Proposal will not impact significant landforms.	×
	Subterranean Fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	The Proposal is in sandy soils (not suitable for troglofauna) and is located above the groundwater table and will not, therefore, impact stygofauna present within the aquifer.	×
	Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	The Proposal has the potential for impacts to this environmental factor through the potential disturbance of ASS and soil contamination from pipeline leaks during operation of the wastewater pipeline.	✓

Theme	Factor	Objective	Relevance to Proposal	Key Environmental Factor?
	Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	The Proposal may result in the clearing of fauna habitat. The open trench construction method may result in entrapment of fauna.	✓
Water	Inland Waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	The Proposal is located within a P1 UWPCA.	✓
Air	Air Quality	To maintain air quality and minimise emissions so that environmental values are protected.	The Proposal does not include activities with significant emissions of harmful substances to air.	×
	Greenhouse Gas Emissions		The Proposal will not result in significant greenhouse gas emissions above the threshold detailed in the guideline.	×
People	Social Surroundings	To protect social surroundings from significant harm.	No Aboriginal or Historic heritage sites occur along the pipeline alignment. The Proposal will not impact the amenity along the pipeline alignment Construction impacts related to noise, vibration and dust will be temporary	×
	Human Health	To protect human health from significant harm.	No human health impacts are expected. No radiation emissions will result from the Proposal.	×

6.3 Flora and Vegetation

6.3.1 EPA Objective

The EPA's objective for the Flora and Vegetation environmental factor is 'to protect flora and vegetation so that biological diversity and ecological integrity are maintained'.

6.3.2 Policy and Guidance

The following EPA policies and guidelines have been considered for the Proposal in order to meet the EPA's objective in relation to this factor:

- *Statement of Environmental Principles, Factors and Objectives* (EPA, 2020b);
- *Environmental Factor Guideline – Flora and Vegetation* (EPA, 2016a); and
- *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b).

The Environmental Factor Guideline has been considered during the identification of flora and vegetation values within the Development Envelope and the issues identified in the guideline considered in relation to potential impacts from the Proposal.

Flora and vegetation surveys have been planned and executed in accordance with the EPA's technical guidance for this factor. Survey limitations relative to the technical guidance have been noted in the flora and vegetation survey reports.

6.3.3 Receiving Environment

6.3.3.1 Surveys and Studies

Desktop assessments, Targeted Surveys and Detailed Surveys, as defined in Sections 4.2 and 4.3 of the Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b), have been undertaken to gain an understanding of the flora and vegetation composition of the Development Envelope. The following flora and vegetation studies were completed for the Proposal and are provided in **Appendix B**:

- AECOM (2018b). Flora, Vegetation and Fauna Assessment. Ellenbrook Barrambie CS00854.

  A desktop and field flora and vegetation survey were undertaken in 2017 to inform the Proposal and alignment selection (AECOM, 2018a). As three alignments within the environmentally sensitive area were originally being explored, the survey area encompassed each of these areas. Field surveys were carried out over three days in October 2017
- AECOM (2020). Flora, Vegetation, Fauna and Targeted Black Cockatoo Survey. Ellenbrook Barrambie CS00854.

  A desktop and detailed flora and vegetation assessment was undertaken on 20 September and 15 October 2019. The field survey was undertaken on 20 September and 15 October 2019. Eight quadrats and three relevés points where assessed and the dataset supplemented by data from surveys undertaken for the Water Corporation Alkimos Investigations Project, Ellenbrook Rapid Bus Transit Corridor and the 2017 Ellenbrook Barrambie CS00854 survey (AECOM 2020).

6.3.3.2 Vegetation

Vegetation Communities

The vegetation complexes of the Development Envelope have been mapped at a broad scale by Heddle et al. (1980) as Bassendean Complex – Central and South. This vegetation complex is described as ranging from

woodland of *Eucalyptus marginata*, *Allocasuarina* and *Banksia* on sand dunes to a low woodland of *Melaleuca* species and sedgelands on the low-lying depressions and swamps (Heddle et al., 1980).

The field surveys conducted by AECOM (2018b; 2020) identified eight native vegetation communities within or adjacent to the Development Envelope (**Table 6-3**). Four completely degraded areas were also mapped including paddocks, planted vegetation, isolated native Eucalypts and *Xanthorrhoea preissii* plants in otherwise cleared paddocks. The vegetation mapping prepared by AECOM (2020) is shown on **Figure 4**.

Table 6-3: Vegetation types within the Development Envelope (AECOM, 2018b; 2020).

Type	Description
BlEpPo	*Banksia littoralis, Banksia menziesii* and *Nuytsia floribunda* low open woodland over *Eremaea pauciflora* and *Scholtzia involucrata* low shrubland over *Patersonia occidentalis, Mesomelaena pseudostygia* and *Lyginia barbata* low sedge and herbland Represents the Banksia Woodlands TEC Inferred as FCT23b Northern *B. attenuata-B. menziesii* woodlands which is listed as a Priority 3 PEC
BmCfMp	Banksia *menziesii*, Banksia *attenuata* and *Nuytsia floribunda* low open woodland over *Calytrix fraseri*, *Stirlingia latifolia*, *Hibbertia hypericoides* and *Hibbertia huegelii* low open shrubland over *Mesomelaena pseudostygia*, *Patersonia occidentalis* and *Lomandra caespitosa* low open herb and sedgeland Represents the Banksia Woodlands TEC Inferred as FCT23a Central *B. attenuata-B. menziesii* woodlands which is listed as a Priority 3 PEC
CcBmMs	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* mid woodland over *Banksia menziesii, Banksia attenuata* and *Nuytsia floribunda* low woodland over *Melaleuca seriata, Hibbertia subvaginata* and *Xanthorrhoea preissii* mid to low shrubland Represents the Banksia Woodlands TEC Inferred as FCT21c Low lying *B. attenuata* woodlands or shrublands which is listed as a Priority 3 community
CcXpPo	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* mid woodland over *Xanthorrhoea preissii, Hibbertia subvaginata* and *Petrophile linearis* mid to low shrubland over *Patersonia occidentalis, Lagenophora huegelii* and *Burchardia congesta* low sparse herbland.
MpXpPo	*Melaleuca preissiana* and *Nuytsia floribunda* low open woodland over *Xanthorrhoea preissii, Banksia dallanneyi* and *Regelia inops* mid to low shrubland over *Patersonia occidentalis, Ursinia anthemoides** and *Hypochaeris glabra** herbland Includes sedges *Schoenus subfasciculatus, Lyginia imberbis* and sparse grasses
BmJsMp	*Banksia menziesii, Banksia attenuata* and occasional *Eucalyptus marginata subsp. marginata, Eucalyptus todtiana* and *Allocasuarina fraseriana* low open woodland over *Jacksonia sericea (P4), Hibbertia hypericoides, Gompholobium tomentosum, Daviesia triflora* and *Xanthorrhoea preissii* mid open shrubland over *Mesomelaena pseudostygia, Lepidobolus preissianus, Tetraria octandra, Tetraria capillaris* and *Lepidosperma pubisquameum* low sedgeland with *Conostylis aurea, Patersonia occidentalis, Thysanotus dichotomous, *Ursinia anthemoides* and *Dasypogon bromeliifolius* low sparse herbland
CcXpBm	*Corymbia calophylla* and *Melaleuca preissiana* mid open forest over *Xanthorrhoea preissii, Dasypogon bromeliifolius* and *Patersonia occidentalis* sparse shrubland over *Briza maxima, Alexgeorgea nitens, *Ehrharta longiflora* low to mid mixed tussock grassland and sedgeland. *Eucalyptus marginata, Nuytsia floribunda, Allocasuarina sp.* and Banksia species are intermittent. In degraded versions of this community the understorey is dominated by grasses
Xp	*Xanthorrhoea preissii* over common pasture weeds

Vegetation Condition

The condition of native vegetation mapped by AECOM (2018b; 2020) ranged from Very Good to Completely Degraded (**Figure 5; Table 6-4**). The area surveyed includes mostly roadside vegetation which suffers from ongoing degrading processes associated with urban development (AECOM, 2020).

Table 6-4: Condition of Native Vegetation Mapped by AECOM (2018b; 2020)

Vegetation Condition	Extent (ha)
Very Good	4.28
Good	0.57
Degraded	2.59
Completely Degraded	11.40

In addition, within the survey area along the preferred pipeline route, 77 ha was mapped as cleared or paddock, 7.5 ha was mapped as planted or rehabilitation and 3 ha was mapped as Pine Plantation, all of which are considered Completely Degraded (AECOM 2018b; 2020).

Threatened and Priority Ecological Communities

The AECOM (2018b; 2020) desktop assessments identified one TEC listed under the EPBC Act, one TEC listed under the *Biodiversity Conservation Act 2016* (BC Act) and four Priority Ecological Communities (PEC), listed as Priority 3 by DBCA, as known to occur or likely to occur within the Development Envelope. These TECs and PECs are:

- Banksia Woodlands of the Swan Coastal Plain TEC (Banksia Woodlands TEC) – listed as Endangered under the EPBC Act. The Banksia Woodlands TEC was listed under the EPBC Act as Endangered on 16 September 2016. It incorporates woodland of Banksia species with scattered Eucalypts and other tree species over a species rich mix of sclerophyllous shrubs, graminoids, and forbs. The community shows high endemism and considerable local variation in species composition across its range. It is restricted to the southwest of Western Australia on the Swan Coastal Plain. It occurs mainly on deep Bassendean and Spearwood sands or occasionally on Quindalup sands (AECOM, 2018).
- Banksia attenuata woodlands over species rich dense shrublands (Floristic Community Type (FCT) 20a) TEC – listed as Endangered under the BC Act;
- Banksia Dominated Woodlands of the Swan Coastal Plain PEC – listed as Priority 3 by DBCA;
- Banksia ilicifolia woodlands (FCT22) PEC – listed as Priority 3 by DBCA;
- Low lying Banksia attenuata woodlands or shrublands (FCT221c) – listed as Priority 3 by DBCA; and
- Swan Coastal Plain *Banksia attenuata – Banksia menziesii* woodlands (FCT23b) PEC – listed as Priority 3 by DBCA.

The field survey undertaken by AECOM (2020) confirmed the presence of the Banksia Woodlands TEC within the Development Envelope. This TEC is represented by AECOM (2020) vegetation types BlEpPo, BmCfMp, CcBmMs and CcXpPo with 2.94 ha mapped within and adjacent to the Development Envelope (**Figure 6**).

AECOM (2020) also identified the following two Priority 3 PECs within the area surveyed (**Figure 6**):

- Banksia Dominated Woodlands of the Swan Coastal Plain. The identification of this PEC is based on its association with the EPBC listed Banksia Woodlands TEC, rather thana specific FCT or vegetation type. A total of 2.24 ha of the PEC was mapped by AECOM (2020).
- SCP23b Northern B. attenuata-B. menziesii woodlands. The PEC is represented by vegetation type BlEpPo with 0.52 ha mapped by AECOM (2020). This PEC is not within the Development Envelope

Both of these PECs are also components of the EPBC listed Banksia Woodlands TEC.

Bush Forever and Environmentally Sensitive Areas

Three Bush Forever Sites are adjacent to the Development Envelope (**Table 6-5**). Bush Forever Sites are recognised for their representation of ecological communities, diversity and rarity as well as scientific or evolutionary importance (AECOM, 2020). Some also protect wetlands, estuarine fringing vegetation and coastal vegetation (Government of Western Australia, 2000).

Table 6-5: Bush Forever Sites in the Vicinity of the Development Envelope

Site No.	Location
193 Gnangara Lake and Adjacent Bushland	North of Gnangara Road/Alexander Drive Intersection associated with Lake Gnangara. This site is not within the Development Envelope.
196 Gnangara Road Bushland	Corner Alexander Drive/Gnangara Road (southeast) on Telstra-owned land. The northern edge of this site is within the Development Envelope.
304 Whiteman Park	Whiteman Park. This site is not within the Development Envelope.

6.3.3.3 Flora

AECOM (2018b) identified 133 flora species from 92 genera and 35 families across the entire survey are, which covered pipeline route options 1, 2 and 3. The majority of species identified (115; 86%) are native with the remaining 18 species (14%) identified as weed species. The 2019 field survey (AECOM, 2020) identified a total of 122 flora species from 92 genera and 35 families. Of these, 104 flora species are native (85%) species and 18 (15%) are weed species.

AECOM (2018b; 2020) did not identify any species listed as Threatened under the BC Act or the EPBC Act. One Priority 3 species (*Styphelia filifolia*) was recorded at one location just outside of the Development Envelope (**Figure 4**). *Styphelia filifolia* is from the Ericaceae family. It occurs sporadically from north of Eneabba to the Harvey area where it is found on sandy soils of the coastal plain, usually in Banksia or Jarrah woodland and in low-lying situations. (AECOM, 2020).

6.3.3.4 Weeds and *Phytophthora* Dieback

A total of 18 weed species were recorded by AECOM (2018b; 2020) within or adjacent to the Development Envelope. None of these weed species were identified as Declared Pest species listed under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) or Weeds of National Significance. Weed species identified were considered locally and regionally common, in particular along roadsides, cleared paddocks and on the edge of remnant native vegetation patches.

A review of the mapping available on the Project Dieback public dieback map (South Coast NRM, 2020) indicates that a portion of Bush Forever Site 196 is dieback infested with the remainder mapped as dieback free. This data is accurate up to 2008, and the boundary of the infested area is likely to have grown.

6.3.4 Potential Impacts

Potential direct and indirect impacts to flora and vegetation within the Development Envelope may result from the following project activities:

- Clearing for the pipeline trench;
- Clearing for associated construction activities such as laydown areas and side-tracks;

- Movement of construction vehicles and machinery around the site;
- Introduced disease, weeds and dieback through vehicle movement; and
- The potential of a pipeline burst and leaking wastewater into the surrounding vegetation.

The following impacts are anticipated as a result of implementation of the Proposal:

- Permanent loss of native vegetation within the Development Footprint due to clearing for construction.
- Permanent loss of the EPBC Act listed Banksia Woodlands TEC and DBCA listed Priority 3 PECs within the Development Footprint due to clearing for construction.

The following indirect impacts may arise as a result of implementation of the proposal:

- Degradation of native vegetation associations or TEC due to introduction and/or spread of weeds or *Phytophthora* dieback.

6.3.5 Assessment of Impacts

6.3.5.1 Native Vegetation

Impacts to native vegetation have been avoided and minimised where practicable during the planning and design phases through preferentially locating the wastewater pipeline alignment in previously cleared areas. This approach has resulted no more than 0.3 ha of native vegetation, within a Development Envelope of 30 ha, being cleared for construction of the Proposal. Clearing by vegetation type is present in **Table 6-6**. The vegetation communities mapped by AECOM (2020) extend well beyond the area surveyed with 217 ha of native vegetation present within Bush Forever Site 196 and 759 ha present on the portion of Whiteman Park west of Tonkin Highway (**Figure 7**).

Table 6-6: Vegetation Types and Clearing Requirements

Vegetation type	Estimated Clearing Extent (ha)	Extent Mapped by AECOM (2018b; 2020) (ha)	% Mapped Extent Cleared
BmCfMp	0.002	1.44	0.1
CcBmMs	0.005	0.35	1.4
CcXpPo	0.05	4.36	1.1
MpXpPo	0.03	2.62	1.1
Xp	0.20	3.21	6.2
Pine Plantation*	0.60	3.0	20*
Planted Vegetation	1.60	7.0	22.9
Paddocks and other Cleared Areas	28.3	77.0	36.8

* AECOM (2018b) mapping of the Pine Plantation covers the edge only. Actual size of the plantations is in excess of 10,000 ha.

At a regional scale, vegetation may be considered significant where less than 30% of the pre-European extent remains. Species loss appears to accelerate at the ecosystem level when less than 30% of the pre-European vegetation extent remains for a particular vegetation complex (ANZECC, 2000). Vegetation below this threshold is considered under-represented and at danger of further loss. The Bassendean Complex – Central and South is below or close to the 30% threshold both at a subregional scale and local government scale (**Table 6-7**).

However, the small amount of clearing required for the Proposal is unlikely to significantly alter the remaining extent of the vegetation complex such that it would be at a higher risk of further loss.

Table 6-7: Bassendean Complex – Central and South Extent Remaining

Scale	Pre-European Extent (ha)	Current Extent (ha)	Extent Remaining (%)
Perth Subregion	87,476.26	23,508.66	26.87
City of Wanneroo	924.98	208.60	22.55
City of Swan	4,676.35	1,470.94	31.45

6.3.5.2 Conservation Significant Vegetation

No more than 0.06 ha of the EPBC listed Banksia Woodlands TEC will be cleared for the Proposal. This vegetation is also representative of the DBCA Priority 3 listed Banksia Dominated Woodlands of the Swan Coastal Plain PEC. To determine the likelihood of significant impact in relation to the TEC, and therefore the PEC, an assessment against the EPBC Act Significant Impact Criteria was undertaken (**Table 6-8**). This assessment identified that, while some clearing within the ecological community is required, the Proposal is unlikely to result in a significant impact to the Banksia Woodlands TEC.

Table 6-8: EPBC Act Significant Impact Criteria Assessment for Banksia Woodlands

Significant Impact Criteria	Description of proposed action in relation to significant impact criteria	Likelihood of Significant Impact
Reduce the extent of the ecological community.	Some clearing along the edge of the Banksia Woodlands TEC will be required; however, this will not materially reduce the extent of the ecological community. Topsoil in areas of native vegetation will be stripped and retained for use in reinstatement, which will assist in reestablishment of native vegetation in these areas.	Low
Fragment or increase fragmentation of the ecological community.	As clearing required will occur along the edge of the vegetation patch, the Proposal will not result in fragmentation of the ecological community.	Nil
Adversely affect habitat critical to the survival of the ecological community.	A small amount of clearing will be required along the edge of the mapped Banksia Woodlands TEC occurrence. This clearing will be less than 2 m in width and is unlikely to adversely affect critical habitat for the ecological community. Topsoil from areas of native vegetation will be stripped and used in reinstatement of the Development Envelope, which will assist in reestablishment of vegetation along the northern edge of the ecological community.	Low
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of	The Proposal is largely located in areas that have already been disturbed during road construction and installation of other infrastructure (e.g., water supply pipelines).	Low

Significant Impact Criteria	Description of proposed action in relation to significant impact criteria	Likelihood of Significant Impact
groundwater levels, or substantial alteration of surface water drainage patterns.	The Proposal is unlikely to increase the level of disturbance already present within the soil, groundwater or surface waters.	
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species.	The small amount of clearing required will not change the species composition of the Banksia Woodlands TEC adjacent to the Development Envelope. Management measures in place during construction will minimise the risk of the spread of weeds and disease that could result in substantial change in the species composition.	Low
Cause a substantial reduction in the quality or integrity of an occurrence of the ecological community, including, but not limited to: ▪ assisting invasive species, that are harmful to the listed ecological community, to become established, or ▪ causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.	AECOM (2020) noted that several weed species are already present within the areas mapped as the Banksia Woodlands TEC. A portion of the Development Envelope and adjacent areas has also been mapped as Dieback infested. Management measures such as clean on entry/exit protocols will be in place during construction and it is therefore considered unlikely that the Proposal will increase the risk posed from weeds or disease. The Proposal will not disturb known or suspected contaminated sites that could indirectly impact the ecological community through the mobilisation of pollutants.	Low
Interfere with the recovery of the ecological community.	There are currently no recovery actions being undertaken in relation to the properties on which the Proposal is located.	Nil

6.3.5.3 Bush Forever Site196

Minimal clearing (0.25 ha) will be required along the edge of Bush Forever Site 196 to allow for construction of the pipeline. This clearing represents approximately 0.1% of the total area of vegetation within the site and therefore is unlikely to adversely impact the overall values of the site. There is potential for existing *Phytophthora* Dieback within the site to be spread during construction to Dieback free areas; however, management measures such as clean on entry and exit protocols will be in place.

6.3.5.4 Weeds and *Phytophthora* Dieback

Weeds are known to occur throughout the Development Envelope. Introduced species can establish in areas of native vegetation, gradually encroaching from the edges where native vegetation abuts cleared land. The Proposal has the potential to introduce new weeds or spread existing weeds; however, as the majority of the Development Envelope is previously cleared land, the Proposal is unlikely to increase the risk of weed encroachment into areas of native vegetation.

Spread of dieback as a result of implementation of the Proposal has the potential to cause significant degradation to native vegetation, particularly Banksia woodlands and Jarrah/Marri woodlands, as these vegetation associations contain a high proportion of susceptible species. In particular, the EPBC Act listed Banksia Woodlands TEC contains several species that are susceptible to dieback.

Dieback management during construction is a standard practice in the southwest of Western Australia and will be implemented for the Proposal. Appropriate management and mitigation controls will be in place, and it is unlikely that implementation of the Proposal will result in the spread or introduction of dieback.

6.3.6 Mitigation

The mitigation hierarchy has been implemented throughout the planning and design of the Proposal and will continue to be implemented throughout construction and operation. Impacts to flora and vegetation have been avoided and minimised by preferentially locating the wastewater pipeline alignment in cleared areas. To further minimise and mitigate potential impacts to flora and vegetation, the following management measures, actions and controls are proposed:

- **Avoid**
  - In areas where the Development Envelope is adjacent to native vegetation, the boundary of the Development Envelope shall be clearly marked on site to avoid accidental clearing or disturbance of native vegetation.
  - The location of the Priority 3 flora species (*Styphelia filifolia*) which is just outside of Development Envelope, shall be clearly marked with flagging so the plant is not accidentally cleared or otherwise disturbed.
- **Minimise**
  - Construction personnel to stay within the designated Development Envelope and access to be via approved access points.
  - All plant and equipment will be certified as clean and free of soil or vegetative matter before accessing the construction site in areas adjacent to native vegetation.
  - Clean on Entry and Exit points will be established at the boundaries of the dieback infested area within Bush Forever Site 196.
  - Any additional areas required for infiltration ponds will be in already cleared areas.
- **Rehabilitate**
  - Topsoil from areas within or adjacent to native vegetation will be stripped and stockpiled for use in rehabilitation of the Development Envelope.

6.3.7 Predicted Outcome

The Proposal will result in the clearing of native vegetation, components of which may be regionally significant as they support Priority flora species, DBCA listed PECs and EPBC Act listed TECs.

The outcomes of the Proposal are predicted to be:

- Clearing of no more than 0.3 ha of native vegetation, of which 0.06 ha is mapped as the Banksia Woodlands TEC and Banksia Dominated Woodlands of the Swan Coastal Plain PEC. This vegetation is also considered to be under-represented with less than 30% remaining at a subregional scale.
- No clearing of Threatened flora species listed under the BC Act or the EPBC Act.
- No introduction or spread of weeds or dieback.

While clearing of under-represented vegetation, some of which is TEC and PEC, is required, the small scale of the clearing is unlikely to result in impacts that would alter the health, composition or remaining extent of the vegetation complex such that it would be at a higher risk of further loss.

Based upon the nature and scale of the Proposal and the proposed management measures, the EPA's objective for this factor can be met.

6.4 Terrestrial Fauna

6.4.1 EPA Objective

The EPA's objective for the Terrestrial Fauna environmental factor is 'to protect terrestrial fauna so that biological diversity and ecological integrity are maintained'.

6.4.2 Policy and Guidance

The following EPA policies and guidelines have been considered for the proposal in order to meet the EPA's objective in relation to this factor:

- *Statement of Environmental Principles, Factors and Objectives* (EPA, 2020);
- *Environmental Factor Guideline – Terrestrial Fauna* (EPA, 2016c); and
- *Technical Guidance – Terrestrial Fauna Surveys* (EPA, 2016d).

The Environmental Factor Guideline has been considered during the identification of fauna values within the Development Envelope and the issues identified in the guideline considered in relation to potential impacts from the Proposal.

Fauna surveys have been and will continue to be planned and executed in accordance with the EPA's technical guidance for this factor. Any survey limitations relative to the technical guidance will be noted in the fauna survey report.

6.4.3 Receiving Environment

6.4.3.1 Surveys and Studies

Surveys were undertaken of the Development Envelope and surrounding areas to inform Water Corporation of planning for the Proposal. A desktop fauna assessment, fauna field survey and targeted Black Cockatoo field survey have been completed (AECOM, 2018b; 2020). These survey reports are provided in **Appendix B**.

Field surveys reported in AECOM (2018b) were carried out on 24 October 2017 across 15 sites. The assessment included a total of 10 quadrats, five relevés and 21 observation point and covered pipeline route options 1, 2 and 3. Field surveys reported in AECOM (2020) were carried out over three days in October 2019 by means of ten (10 x 10 m) quadrats and five relevés, as well as 21 observation points.

The objectives of the fauna survey were to:

- Conduct an assessment in accordance with methodologies stated in EPA Technical Guidance – Terrestrial Fauna Surveys.
- Record observable evidence of fauna activity at the site.
- Determine potential significant fauna habitats present at the site.
- Assess Black Cockatoo foraging, roosting and breeding habitat.

6.4.3.2 Native Fauna Assemblage

The AECOM (2020) desktop assessment identified 43 conservation significant fauna species that could occur within the Development Envelope. A review of the habitat requirements and distribution of these species resulted in three species identified as 'likely to occur' (**Table 6-9**), eight species that 'may occur' and 32 species that are 'unlikely to occur' (AECOM, 2020). The full list of species and assessment of the likelihood of occurrence is provided in **Appendix B**.

The AECOM (2018b) field survey recorded 37 species comprised of 27 birds, seven mammals and three reptiles. The AECOM (2020) field survey recorded 21 native fauna species, comprising 15 bird species, four mammals and two reptiles. Of the 21 species observed by AECOM (2020), five were of conservation significance (**Figure 8**):

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – listed as Endangered under the EPBC Act and BC Act;
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – listed as Vulnerable under the EPBC Act and BC Act;
- Magpie Lark (*Grallina cyanoleuca*) – listed as Marine under the EPBC Act;
- Black-faced Cuckoo-shrike (*Coracina novaehollandiae*) – listed as Marine under the EPBC Act; and
- Quenda (*Isoodon obesulus fusciventer*) – listed as Priority 4 on the DBCA Priority fauna list.

These species were also recorded by AECOM (2018b). It should be noted that species listed as Marine under the EPBC Act are only considered of conservation significant on Commonwealth land (AECOM, 2020). The Proposal is not within Commonwealth lands.

6.4.3.3 Introduced Species

A search of the EPBC Act Protected Matters Search Tool (PMST) identified 18 invasive fauna species that could occur within the Development Envelope (**Appendix C**):

- Common Myna (*Acridotheres tristis*)
- Mallard (*Anas platyrhynchos*)
- European Goldfinch (*Carduelis carduelis*)
- Rock Pigeon (*Columba livia*)
- House Sparrow (*Passer domesticus*)
- Eurasian Tree Sparrow (*Passer montanus*)
- Spotted Turtle-Dove (*Streptopelia chinensis*)
- Laughing Turtle-dove (*Streptopelia senegalensis*)
- Common Starling (*Sturnus vulgaris*)
- Domestic Cattle (*Bos taurus*)
- Domestic Dog (*Canis lupus familiaris*)
- Cat (*Felis catus*)
- Northern Palm Squirrel (*Funambulus pennantii*)
- House Mouse (*Mus musculus*)
- Rabbit (*Oryctolagus cuniculus*)
- Brown Rat (*Rattus norvegicus*)
- Black Rat (*Rattus rattus*)
- Red Fox (*Vulpes vulpes*)

AECOM (2018b; 2020) recorded five introduced species: Cat (*Felis catus*), Domestic Dog (*Canis lupus familiaris*), Domestic Sheep (*Ovis aries*), Red Fox (*Vulpes vulpes*). and Rabbit (*Oryctolagus cuniculus*). Two species native to Australia but introduced or naturalised to Western Australia were also recorded by AECOM (2018b): Laughing Kookaburra (*Dacelo novaeguineae*) and Rainbow Lorikeet (*Trichoglossus moluccanus*)

Table 6-9: Listed Threatened Fauna Species Likely to Occur within the Development Envelope (AECOM, 2020)

Species Name	Common Name	Conservation Status	Species Description	Comments
Calyptorhynchus latirostris	Carnaby's Cockatoo	Endangered (BC Act and EPBC Act)	Carnaby's Cockatoo is a postnuptial nomad and typically moves west soon after breeding. The species nests in hollows of smooth-barked eucalypts, particularly Salmon Gum (*Eucalyptus salmonophloia)* and Wandoo (*E. Wandoo)* but is not limited to these eucalypts. Diet consists of an array of Proteaceous and Eucalypt species prevalent on the Swan Coastal Plain. Foraging habitat, including *banksia* woodlands, is considered to be habitat critical to the survival of the species (Johnstone et al., 2010). The DAWE modelled distribution of the Carnaby's cockatoo shows the Development Envelope is located in an area where this species may occur (DAWE, 2020b).	Foraging and breeding habitat were mapped within the survey area.
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	Vulnerable (BC Act and EPBC Act)	The Forest Red-tailed Black Cockatoo requires tree hollows of Karri (*E. diversicolor*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) forests to nest and breed. Flocks move out onto the Swan Coastal Plain in search of food from exotic trees such as the White Cedar (Johnstone et al., 2010). The foraging habitat for the species consists of Jarrah and Marri woodlands and forest within its range. The DAWE modelled distribution of the Forest Red-Tailed Black-Cockatoo shows the Development Envelope is located in an area where this species may occur (DAWE, 2020b).	Foraging and breeding habitat were mapped within the survey area.
Isoodon obesulus fusciventer	Quenda	DBCA Priority 4	The Quenda or Southern Brown Bandicoot exists only in a fragmented distribution to its former range in southern south western and eastern Australia. It is found in forest, woodland, heath and shrub communities in these regions. Preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation (Van Dyck and Strahan 2008).	An individual was observed during the survey and many of the fauna habitats mapped within the survey area would potentially be used by Quenda.

6.4.3.4 Fauna Habitat

AECOM (2018b; 2020) defined eight fauna habitats as follows (**Figure 8**):

- **Eucalypt Woodland**: open eucalypt woodland of Marri and Jarrah over an open layer of Banksia over a variable mid to low shrubland layer. Provides foraging, breeding and roosting habitat for the Forest Red-tailed Black Cockatoo and Carnaby's Cockatoo, and habitat for Quenda.
- **Banksia Woodland**: Banksia woodland with occasional *Eucalyptus todtiana* over a highly variable understorey. Provides foraging habitat for Carnaby's Cockatoo and habitat for Quenda.
- **Mixed Open Forest**: open canopy of scattered predominantly large, mature eucalypts, over a highly variable cover understorey.
- **Open Shrubland**: a varied density shrubland with minimal to no vegetative groundcover. It often comprises cleared areas that have been rehabilitated, and / or monocultures of grasstrees. Provides habitat for Quenda.
- **Isolated Trees**: scattered, isolated or clumps of mature eucalypts or Banksia, generally within cleared paddocks with minimal understorey. Provides foraging, breeding and roosting habitat for the Forest Red-tailed Black Cockatoo and Carnaby's Cockatoo. Marginal habitat for Quenda.
- **Wetlands, Riparian Vegetation and Drainage Ponds**: mature Paperbarks over either a cleared understorey with weeds and herbs or an understorey containing an open shrubland over sandy whitish grey soils. Marginal habitat for Quenda.
- **Parkland, Planted Trees and Maintained Gardens**: planted and maintained native and introduced vegetation.
- **Cleared Ground**: generally, areas which have been cleared (e.g., paddocks) and now comprise bare soil and / or weeds (may contain the occasional shrub / tree) or hardstand areas (e.g., roads).

Additional habitats are identified in AECOM (2018b) that were not identified in AECOM (2020), however these occur along the routes of options 2 and 3 and have not, therefore, been considered here.

6.4.3.5 Habitats Supporting Conservation Significant Fauna

Mapped Habitats

The habitats mapped by AECOM (2018b; 2020), which are likely to support conservation significant fauna and expected to occur within the Development Envelope and/or recorded during field surveys, are as follows:

- Carnaby's Cockatoo: Eucalypt Woodland, Banksia Woodland, Isolated Trees and Parkland, Planted Trees and Maintained Gardens (i.e. Pine Plantation). The Open Shrubland habitat provides some additional, though low-quality habitat.
- Forest Red-tailed Black Cockatoo: Eucalypt Woodland, Isolated Trees and Parkland, Planted Trees and Maintained Gardens. The Open Shrubland habitat provides some additional, though low-quality, habitat.
- Quenda: Eucalypt Woodland, Banksia Woodland, Open Shrubland. The Wetlands, Riparian Vegetation and Drainage Ponds and Isolated Trees habitats provide some additional, though low-quality, habitat.

Critical Habitat

Habitats critical to the survival of Carnaby's Cockatoo and the Forest Red-tailed Black Cockatoo have been defined in their respective recovery plans (DPaW, 2013; Chapman, 2008). For Carnaby's Black Cockatoo, critical habitat is identified as (DPaW, 2013):

- the eucalypt woodlands that provide nest hollows used for breeding, together with nearby vegetation that provides feeding, roosting and watering habitat that supports successful breeding;

- woodland sites known to have supported breeding in the past and which could be used in the future, provided adequate nearby food and/or water resources are available or are re-established;
- in the non-breeding season, the vegetation that provides food resources as well as the sites for nearby watering and night roosting that enable the cockatoos to effectively utilise the available food resources.

Critical habitat for the Forest Red-tailed Black Cockatoo consists of Marri, Karri and Jarrah forests, woodlands and remnants in the south-west of Western Australia that receive 600 mm or more annual average rainfall (Chapman, 2008).

6.4.3.6 Black Cockatoo Habitat

Carnaby's Cockatoo was mapped by AECOM (2018b; 2020) within the Development Envelope. They are an endemic species to the southwest of Western Australia. The species feeds on seeds, nuts, and flowers of a variety of plants which include *Banksia*, *Grevillea* and *Hakea*. Numerous studies and surveys have found its breeding habitat has been expanding to the Swan Coastal Plain (AECOM, 2020).

The Forest Red-tailed Black Cockatoo is also endemic to the south-west humid and semi-humid zones of Western Australia, where it inhabits dense Jarrah, Karri and Marri forests. This species predominantly feeds in eucalypt trees. Its breeding habitat is now being seen within small patches utilised across the Swan Coastal Plain (AECOM, 2020).

The surveys undertaken by AECOM (2018b; 2020) identified foraging and potential breeding habitat for Carnaby's Cockatoo and the Forest Red-tailed Black Cockatoo (**Table 6-10**, **Figure 9** and **Figure 10**).

Table 6-10: Black Cockatoo Foraging Habitat Mapped by AECOM (2018b; 2020)

Foraging Quality	Carnaby's Cockatoo (ha)		Forest Red-tailed Black Cockatoo (ha)	
	AECOM (2018b)*	AECOM (2020)	AECOM (2018b)*	AECOM (2020)
Low Quality	16.15	4.14	20.18	2.25
Quality	9.33	0.36	8.77	0.21
High Quality	15.37	0.00	1.49	0.00
Very High Quality	16.65	8.36	10.31	6.57
Total	**57.50**	**13.16**	**40.75**	**9.03**

* The AECOM (2018b) survey covers pipeline route options 1, 2 and 3. This survey also covered some areas surveyed by AECOM (2020).

AECOM (2018b) identified 454 potential breeding trees with a diameter at breast height greater than 500 mm with 16 of these having hollows suitable for use by either Carnaby's Cockatoo or the Forest Red-tailed Black Cockatoo. A total of 167 potential breeding trees with a diameter at breast height greater than 500mm were mapped by AECOM (2020), 11 of which had hollows suitable for use by either Carnaby's Cockatoo or the Forest Red-tailed Black Cockatoo. Two potential breeding trees are within the Development Envelope though neither of these have suitable hollows.

The Development Envelope is situated between several large areas of fauna habitat suitable for Black Cockatoos, including Whiteman Park and surrounds to the south and Lake Gnangara Park and Gnangara Park to the north (AECOM, 2020). The Eucalypt and Banksia woodlands and scattered mature eucalypts of Whiteman Park and surrounds provides foraging roosting and breeding habitat for Carnaby's Black Cockatoo and the Forest Red-tailed Black Cockatoo while the pine plantation of Gnangara Park provides foraging habitat for Carnaby's Cockatoo.

6.4.4 Potential Impacts

Potential direct and indirect impacts to terrestrial fauna within the Development Envelope may result from the following project activities:

- Clearing for the pipeline trench;
- Clearing for associated construction activities such as laydown and side-tracks;
- Movement of construction vehicles and machinery around the site; and
- Physical presence of the open trench.

The following impacts have the potential to result from implementation of the Proposal:

- Permanent loss of fauna habitat;
- Permanent loss of foraging and breeding habitat for Black Cockatoos;
- Habitat degradation due to introduction or spread of weed or dieback;
- Fauna mortality from vehicle strikes; and
- Entrapment of fauna in the open trench and/or pipeline.

6.4.5 Assessment of Impacts

6.4.5.1 Fauna Habitat

The majority of the Development Envelope consists of previously disturbed and cleared land. These areas offer limited or no habitat value for native fauna in general. A small amount of clearing within areas of fauna habitat will be required, as detailed in **Table 6-11**. Clearing will be undertaken along the edge of fauna habitats to a maximum of 2 m. As these habitats extend south into the surrounding properties, this small loss from the edge of the habitat is unlikely to adversely impact fauna species found in the area.

Clearing will not result in fragmentation of habitat. The road reserve for Gnangara Road constitutes an existing barrier to movement of ground dwelling fauna, though birds, such as Black Cockatoos, are able to cross into habitat north of Gnangara Road. The additional clearing will not add to this barrier.

Two large Marris (*Corymbia calophylla*) will be cleared due to their proximity to the wastewater pipeline alignment. While the trunk of these trees is not directly over the proposed alignment, it is likely that open trench operations will significantly impact the root zone, cutting through roots and destabilising the trees. All other trees have been avoided.

Table 6-11: Fauna Habitats and Clearing Requirements

Habitat	Estimated Clearing Extent (ha)
Eucalypt Woodland	0.165
Banksia Woodland	0.006
Mixed Open Forest	0.010
Open Shrubland	0.150
Isolated Trees	0.014
Parkland, Planted Trees and Maintained Gardens	1.984
Total	**2.329**

6.4.5.2 Conservation Significant Species

Black Cockatoos

A small amount of foraging habitat for Black Cockatoos will be cleared for the Proposal (**Table 6-12**). As these habitats extend south into the surrounding properties and additional foraging habitat is found immediately north of Gnangara Road, this small loss from the edge of the habitat is unlikely to adversely impact either Carnaby's Black Cockatoo or the Forest Red-tailed Black Cockatoo.

As mentioned above, two large Marri (*Corymbia calophylla*) will be cleared due to their proximity to the wastewater pipeline alignment. These trees have been identified as potential breeding trees but do not have hollows suitable for either Black Cockatoo species. As a further 165 potential breeding trees were mapped by AECOM (2020) with 454 trees mapped by AECOM (2018), and additional trees are likely to be present in the properties to the south of the Development Envelope, the loss of these two trees is unlikely to adversely impact either Carnaby's Black Cockatoo or the Forest Red-tailed Black Cockatoo.

Clearing of pine trees to the north of Gnangara Road will be avoided where practicable, however a maximum clearing extent of 0.6 ha has been allowed for. It is expected that clearing of pine trees in a small area of the pine plantation adjacent to the western side of Tonkin Highway (about 0.1 ha) will be unavoidable, though this will not significantly reduce the area of pines available for foraging by Carnaby's Cockatoo.

Table 6-12: Black Cockatoo Foraging Habitat and Clearing Requirements

Foraging Quality	Clearing Requirements	
	Carnaby's Cockatoo (ha)	Forest Red-tailed Black Cockatoo (ha)
Low Quality	0.23	0.04
Quality	0.14	0.00
High Quality	0.00	0.00
Very High Quality	0.06	0.06
Total	**0.43**	**0.10**

Quenda

Quenda are a medium sized ground dwelling marsupial endemic to the south west of Western Australia (Paull, 2008). They are mostly nocturnal but are known to be active during the day, particularly during winter (DBCA, 2017). While their natural habitat consists of areas with dense understory such as wetlands, banksia and eucalypt woodlands, Quenda have adapted to urban and suburban habitats including gardens, parks and remnant bushland in urban areas (DBCA, 2017). They have varied home-range sizes of 0.5 ha up to 5 ha, depending on habitat connectivity and suitability (Paull, 2008).

Quenda may come into the Development Envelope at night to search for food in trench spoil stockpiles. Given the exposed nature of the majority of the Development Envelope they are unlikely to travel extensively beyond the vegetation line, though there is a possibility they have become entrapped in the open trench. The provision of fauna fencing, escape ramps and daily inspections will reduce the risk of Quenda becoming trapped in open trench areas.

6.4.5.3 Other Fauna Species

Lizards, geckos, snakes and small mammals may become trapped within sections of open trench or within pipe sections that are left open overnight. Though rare, kangaroos have been known to become trapped within open trenches and may be injured from the fall. The provision of fauna fencing, escape ramps and daily inspections

will reduce the risk of fauna becoming trapped in open trench areas. The capping of pipeline sections at the end of each shift will eliminate the risk of fauna becoming trapped within the pipeline.

Noise will be generated during construction activities. As the Development Envelope is located adjacent to Gnangara Road, noise emissions are unlikely to be significantly increased over those already present. Noise from construction will be short term. No noise will be generated during operation of the wastewater pipeline. Fauna may move away from the construction area into bushland to the south due to noise and the physical presence of construction equipment and workers but are expected to return once construction is complete.

6.4.6 Mitigation

The mitigation hierarchy has been implemented throughout the planning and design of the Proposal and will continue to be implemented construction and operation. Impacts to terrestrial fauna have been avoided and minimised by preferentially locating the wastewater pipeline alignment in cleared areas. To further minimise and mitigate potential impacts to terrestrial fauna, the following management measures, actions and controls are proposed:

- **Avoid**
  - In areas where the Development Envelope is adjacent to native vegetation, the boundary of the Development Envelope shall be clearly marked on site to avoid accidental clearing or disturbance of native vegetation.
- **Minimise**
  - Fauna spotters will be engaged during clearing activities in areas of native vegetation to supervise the dispersal and/or relocation of fauna.
  - Clearing will be undertaken at a constant speed and in one direction in order to allow fauna time to move from the area.
  - Sections of trench that will remain open for longer than one shift will include escape ramps for fauna.
  - The amount of open trench will be limited to 100 m at any one time.
  - Areas of open trench will be inspected by suitably qualified person/s each morning to detect and relocate trapped fauna.
  - Where open trenches are left open for extended periods between shifts, trenches shall be fenced to exclude fauna.
  - Pipes will be capped at the end of each shift to avoid fauna being trapped in the pipeline.
  - Injured fauna found within the Development Envelope during the construction period will be assessed by an authorised veterinarian or wildlife carer to determine the appropriate course of action.
- **Rehabilitate**
  - Topsoil from areas within or adjacent to native vegetation will be stripped and stockpiled for use in reinstatement of the construction corridor.

6.4.7 Predicted Outcome

The outcomes of the Proposal are predicted to be:

- Clearing of 2.329 ha of fauna habitat, of which 0.3 ha is habitat within native vegetation areas. The total includes 0.43 ha of foraging habitat for Carnaby's Black Cockatoo and 0.1 ha of foraging habitat for the Forest Red-tailed Black Cockatoo.
- Clearing of two Black Cockatoo potential breeding trees (without suitable hollows).
- Temporary localised disturbance to local fauna populations arising from dust, light and noise generation during the construction phase.

The required disturbance to fauna habitats, including habitat for conservation significant fauna, is not expected to result in significant impact to fauna, particularly given the presence of extensive areas of habitat immediately adjacent to the Development envelope in Bush Forever Site 196 and Whiteman Park. Based upon the nature and scale of the Proposal and the proposed managed measures, the EPA's objective for this factor can be met.

6.5 Terrestrial Environmental Quality

6.5.1 EPA Objective

The EPA's objective for the Terrestrial Environmental Quality factor is 'to maintain the quality of land and soils so that environmental values are protected.

6.5.2 Policy and Guidance

The following EPA policies and guidelines have been considered for the proposal in order to meet the EPA's objective in relation to this factor:

- *Environmental Factor Guideline Terrestrial Environmental Quality* (EPA, 2016e).
- *Dangerous Goods Safety Act* 2004 and associated Regulations 2007.
- *Contaminated Sites (CS) Act* 2003 and Contaminated Sites Regulations 2006.
- Environmental Protection (Controlled Waste) Regulations 2004.
- *Soil and Land Conservation Act* 1945.
- Environmental Protection (Unauthorised Discharges) Regulations 2004.
- Identification and Investigation of Acid Sulphate Soils and Acidic Landscapes (DER, 2015a).
- Treatment and Management of Soil and Water in the Acid Sulphate Soil Landscapes (DER, 2015b).
- Water Quality Protection Note 10 – Contaminant spills – emergency response WQPN10 (DWER, 2020c).

6.5.3 Receiving Environment

6.5.3.1 Surveys and Studies

A Geotechnical and Environmental Study was completed for the Proposal by Galt Geotechnics in 2019. The purpose of the study was to report the findings of a geotechnical and environmental survey along the proposed wastewater pipeline corridor. The study assessed the subsurface and groundwater levels, provided a contaminated sites assessment in the context of the proposed works, investigated the potential for ASS in accordance with the National Acid Sulphate Soils Guidance and DWER guidelines and advised on the need for ASS and dewatering management plans.

The results of the study are be summarised as (Galt 2019):

- The subsurface conditions were found as comprising mostly of topsoil, sand and cemented sand.
- The historical maximum groundwater elevation is within about 1 m of the surface over most of the Development Envelope.
- The DWER ASS risk map indicates the entire corridor is within an area of 'moderate to low' risk of ASS occurrence.
- There are no DWER contaminated sites that overlap the Development Envelope.
- Laboratory results of contaminants of potential concern showed that values fell below the limit of reporting for the laboratory and/or the adopted assessment criteria.

Relevant findings are discussed below.

6.5.3.2 Soil Description

As noted in Galt (2019), the Perth sheet of the 1:50,000 scale Environmental Geology series map indicates that the Development Envelope is located on a thin layer of Bassendean Sand overlying fine grained soils of the Guildford Formation. The findings of Galt (2019) are generally in accordance with the mapped geology, although clayey soils were generally not encountered within the investigated depth.

The subsurface conditions are broadly consistent and can be summarised as comprising (Galt, 2019):

- TOPSOIL, SAND (SP): fine to medium grained, sub-angular to sub-rounded, grey to dark grey, trace fines, with rootlets/organics, present from the surface to 0.4 m (however generally 0.2 m to 0.3 m thick); overlying
- SAND (SP): fine to medium grained, sub-angular to sub-rounded, pale grey to grey and pale brown to brown, trace fines, present to variable depths, up to the maximum depth investigated of 20 m; locally interbedded with
- Cemented SAND (SP) (localised zones only): fine to medium grained, sub-angular to sub-rounded, brown to dark brown, generally very weakly to moderately cemented (locally known as 'coffee rock'), with occasional well cemented nodules/layers, trace rootlets, trace to with fines; variably present(below the groundwater table) from 1.5 m to 6.0 m.

6.5.3.3 Soil Contamination

Galt (2019) undertook soil testing along the wastewater pipeline alignment to determine if contaminates of potential concern were above the relevant assessment criterial in published guidelines, specifically the National Environmental Protection (Assessment of Site Contamination) Measure and *Assessment and management of contaminated sites* (DER, 2014). Soil samples were specifically assessed again the health investigation levels and health screening levels for commercial and industrial sites (HIL D and HSL D). Results of laboratory testing showed that all samples were below either the limits of detection or the afore mentioned assessment criteria. Galt (2019) further noted that the metal concentrations are considered indicative of background conditions at the site and it was, therefore, unlikely that soils within the corridor have been impacted by contaminants at concentrations that pose a risk to human health or the environment.

6.5.3.4 Contaminated Sites

A search of the DWER contaminated sites database indicates that there are three known contaminated sites in the vicinity of, but not within, the Development Envelope (**Figure 11**):

- Site 1 – Gnangara Liquid Waste Disposal Site - Site 1 is approximately 400 m north of Gnangara Road, within the DBCA managed pine plantation. It was formerly used as a sewage effluent treatment facility and waste disposal site. The site is currently classified as 'Potentially contaminated – investigation required' under the *Contaminated Sites Act 2003* due to contamination of the groundwater by ammonia and heavy metals. DWER reported that in 1994, the contaminated groundwater plume was '600 m wide and 1000 m long of which 500 m was within Whiteman Park' (Galt, 2019). The study by Galt (2019) notes that the groundwater plume extending to the south southeast of the site appears to be crossing Gnangara Road. They further note that only concentrations of nutrients (ammonia, total nitrogen and total phosphorus) and volatile organic compounds (naphthalene and 1, 4-dichlorobeneze) have been recorded above the assessment criteria published in the Contaminated Sites Management Series - Assessment levels for Soil, Sediment and Water (DEC, 2010) in the proximity of the corridor. Any dewatering required in the vicinity for the plume will need to be managed, namely though re-infiltration of water between the excavation and the plume.
- Site 2 – Former Petrol Station (DMO 3178) - Site 2 is located on the northern site of Gnangara Road and was formerly used as a petrol station from 1991 to 2006. Contamination assessments were undertaken between 2006 and 2009. These found that the soil in the centre of the site had been impacted by hydrocarbons, which have been remediated; however, it was also found that the superficial aquifer had been

contaminated by nitrates and was not suitable for potable water use (Galt, 2019). The site is classified as 'Remediated for restricted use'. The new service station has been built on this site.

- Site 3 – Former Market Garden (DMO 68707) - Site 3 is former market gardens located on the southern side of Gnangara Road and west of Alexander Drive. The site is currently classified as 'Remediated for restricted use' on the basis of groundwater being impacted by heavy metals, nutrients and acidity. Asbestos containing material was also noted across the surface of parts of the site.

6.5.3.5 ASS

ASS are naturally occurring soils that contain iron sulphide (iron pyrite) minerals. ASS are benign when in a waterlogged or anoxic state. However, when these soils are exposed to oxygen, the iron sulfides oxidise rapidly producing sulfuric acid. The acidity mobilises many metals and other contaminants that would otherwise be locked in soil sediments. Disturbing ASS and exposing it to oxygen has the potential to cause significant environmental impacts including soil and groundwater acidification, contamination of groundwater through mobilisation of arsenic, heavy metals and other contaminants and loss of biodiversity in impacted areas.

The DWER ASS risk map indicates the entire corridor is within an area of 'moderate to low' risk of ASS occurrence (**Figure 12**). The western extent of the corridor is adjacent to a 'high to moderate' risk area. Galt (2019) confirmed the presence of ASS across the wastewater pipeline alignment within the Cemented Sands.

6.5.4 Potential Impacts

Potential direct and indirect impacts to terrestrial environmental quality within the Development Envelope may result from the following project activities:

- Physical presence of construction vehicles and machinery on site.
- Refuelling of construction vehicles and machinery.
- Exposure of potential ASS during trenching operations.
- Operation of the wastewater pipeline.

The following impacts have the potential to result from implementation of the Proposal:

- Soil contamination resulting from leaks or spills during construction
- Exposure of ASS resulting in:
  - acidic runoff from spoil stockpiles; or
  - acidification of groundwater and mobilisation of metals or other contaminants within the soil.
- Soil contamination resulting from leak of wastewater from the wastewater pipeline during operations.

6.5.5 Assessment of Impacts

Spills and Leaks During Construction

Spills and leaks during construction are most likely to occur during refuelling of equipment or through failure of hydraulic hoses or similar components on construction vehicles and machinery. The volume of spilt material in these cases is anticipated to be small and readily treated using standard spill management measures. Additionally, the amounts of hydrocarbons and other chemicals required to be stored on site during construction will be small in volume. The risk of soil contamination from leaks and spills during construction is, therefore, considered low.

Exposure of ASS

Galt (2019) identified the Cemented Sands within the wastewater pipeline alignment as ASS. Disturbance of the Cemented Sands will require management in line with an ASS Management Plan. An ASS dewatering Management Plan will be submitted to the DWER for approval prior to commencement to construction activities.

Wastewater Pipeline Leaks During Operation

A sewage leak from the wastewater pipeline will result in contamination of the adjacent soil, potentially increasing the nutrient load within the soil. Wastewater is also likely to be high in ammonia and carbon. Contamination of the soil may have a resulting impact on the health of adjacent vegetation, depending upon the volume of wastewater lost and the extent of soil impacted. A wastewater leak may also release pathogens into the soil that could be harmful to the health of humans or wildlife.

Design measures have been implemented to reduce the risk of a leak from the wastewater pipeline including installing dual pipes with isolation valves through the P1 area of the UWPCA and using a pipe material with a high-pressure rating. The pipe sections are also welded at the joints to mitigate any potential for leaks.

6.5.6 Mitigation

The mitigation hierarchy has been implemented throughout the planning and design of the Proposal and will continue to be implemented throughout construction and operation. As detailed in Section 3, the design has incorporated the following measures:

- Use of dual pipeline instead of a large single pipeline. Dual pipelines allow a reduced pipe diameter, which is easier to maintain and repair and which lowers the likelihood of a leak. Dual pipes provide flexibility in allowing one pipeline to be taken offline if required for repairs, again reducing the likelihood of a leak. If there was to be a leak, a smaller diameter pipeline means less volume of wastewater lost, reducing the consequence of the leak.
- Remotely operated isolation valves at a maximum distance of 2 km. This will allow for fast isolation of one section of pipe, should a leak be detected, or to undertake maintenance.
- Non-corrosive pipeline material. This increases the reliability of the pipeline, reducing the likelihood of a leak.
- Pipeline material with a high-pressure rating. This will reduce the likelihood of a leak occurring due to the thickness of the pipeline wall and the ability to manage high internal pressure without compromising the integrity of the pipe.
- Fully welded pipe joints. Flexible joints using couplings with a lower specification would normally be applied to a wastewater pipeline. Fully welded joints significantly increase the reliability of the pipeline, reducing the likelihood of a leak.
- Leak detection, including pump flow rate monitoring, pump power monitoring, acoustic leak surveys and visual inspection.

To further minimise and mitigate potential impacts to terrestrial environmental quality, the following management measures, actions and controls are proposed:

- **Minimise**
  - An ASS Management Plan will be developed and implemented. The plan shall be developed in consultation with the DWER and include impact mitigation measures consistent with the *Treatment and management of soil and water in acid sulfate soil landscapes* (DER, 2015b). This will include neutralisation of excavated ASS material using lime (or similar) to avoid generation of acidic runoff from trench spoil stockpiles.
  - Fuel and chemicals will be stored in an appropriately bunded compound or facility and in accordance with relevant legislation. No fuels or chemicals will be stored within the P1 UWPCA.

- Drip trays will be used during refuelling operations under connection points/couplings to capture drips or accidental overfilling. All refuelling will be undertaken outside the P1 UWPCA.
- Spill response kits will be available at the chemical or fuel storage locations and for works within the UWPCA.
- The pipeline, when installed, will be pressure tested to 1.25 times the maximum allowable operating pressure to confirm the integrity of the pipeline.
- Specific warning signs will be erected at regular intervals to inform the location of the wastewater pipeline to third parties working in the area that may cause damage.

- **Rehabilitate**
  - During rehabilitation of the Development Envelope, dedicated refuelling or chemical storage areas will be assessed for potential soil contamination and remediated if required.
  - All construction wastes, including putrescible wastes, will be removed from the site.

6.5.7 Predicted Outcome

The potential from the construction and operation of the pipeline to impact terrestrial environmental quality is well understood from the studies undertaken, and appropriate mitigation is proposed to manage these impacts to ensure a low risk. It is considered there will not be a significant impact to the quality of land and soils so that environmental values are protected. As a result, the EPA's Objective for this factor will be met.

6.6 Inlands Waters

6.6.1 EPA Objective

The EPA's objective for the Inland Waters environmental factor is 'to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected'.

Inland Waters are defined as 'The occurrence, distribution, connectivity, movement, and quantity (hydrological regimes) of inland water including its chemical, physical, biological and aesthetic characteristics (quality)' (EPA, 2016e). Inland waters include groundwater, such as superficial and confined aquifers, and surface water, such as waterways, wetlands and estuaries (EPA, 2016e).

6.6.2 Policy and Guidance

The following EPA policies and guidelines have been considered for the proposal to meet the EPA's objective in relation to this factor:

- *Statement of Environmental Principles, Factors and Objectives (EPA, 2020b).*
- *Environmental Factor Guideline – Inland Waters (EPA, 2016e).*
- *Contaminated Sites Guidelines (DWER, 2020d).*
- *Environmental Water Provisions Policy for Western Australia (Water and Rivers Commission, 2000).*
- *Water Quality Protection Note 10 – Contaminant spills – emergency response WQPN10 (DWER, 2020).*
- *Water Quality Protection Note – Land use compatibility tables for public drinking water source areas WQPN 25 (DWER, 2016).*

6.6.3 Receiving Environment

As described in the introduction, the key reason for referral of the Proposal is the alignment through a P1 UWPCA. A key requirement of this ERD is to clearly detail the assessments undertaken by Water Corporation, the design features of the pipeline and mitigation measures to support the proposed alignment.

6.6.3.1 Surveys and Studies

Galt (2019) reviewed the available data in relation to the hydrogeology of the Development Envelope and undertook groundwater sampling to determine the current concentrations of a range of metals, nutrients and pollutants of potential concern. Assessment criteria for groundwater were derived from the Assessment of Site Contamination NEPM, *Assessment and management of contaminated sites* (DER, 2014) and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000).

Mirrabooka Wellfield – Vulnerability and Risk Assessment of Wastewater Pressure Main was completed by Water Corporation (2020a) to assess the likelihood of contaminants from the proposed wastewater pipeline (in the event of a leak) impacting Water Corporation drinking water production bores within close proximity to the Development Envelope. The assessment found that the risk of the Proposal to the M300 bores is low. The results of this assessment are discussed further in Section 6.6.5.

Risk to M200 Series Production Wells, completed by Water Corporation (2020b), provided supplementary information to the risk assessment completed in 2018, with a focus on the M200 bores located 2 km south of the Proposal. The assessment was conducted at the request of the DWER, highlighting that while all M300 bores will be turned off during construction and commissioning of the pipeline, the intention is to continue to operate the M200 bores. The assessment found that the wastewater pipeline is unlikely to have any water quality impact on the M200 bores. The results are discussed further in Section 6.6.5.

6.6.3.2 Groundwater

The Development Envelope is within the Gnangara UWPCA (**Figure 13**). Within the area of the Development Envelope, the following groundwater aquifers, in order of depth, are present:

- Superficial Aquifer. The Superficial Aquifer is expected to be up to 50 m thick along Gnangara Road (Water Corporation, 2020a). Groundwater flow is to the south west.
- Leederville Aquifer. Confined by the Kardinya Shale Member of the Osborne Formation in the area of the Development Envelope (Water Corporation, 2018b). There is no connection between the Superficial and Leederville aquifers in this area.
- Yarragadee Aquifer. This major confined aquifer underlays the entire Perth Region. It consists of sandstones, siltstones and shale and is believed to be more than 2,000 metres in thickness. The Yarragadee aquifer is confined by the South Perth Shale, found over most of the region between the Leederville and Yarragadee aquifers (DoW, 2006).

There are six Water Corporation water supply bores along Gnangara Road (known as the M300 bores) that abstract water from the Superficial Aquifer. Of these, three are not currently operational with the remaining three abstracting just 50 ML annually over a period of 30 days, with an expectation that this may be reduced by DWER to zero in future years (Water Corporation, 2020a). The Development Envelope passes through the Wellhead Protection Zones of these bores (**Figure 14**).

Galt (2019) reported the historical maximum groundwater elevation is within about 1 m of the surface over most of the Development Envelope. They noted that the geomorphic wetlands ('Palusplain' and 'Dampland') are present in the eastern and western portions of the corridor.

Analysis of the groundwater samples taken by Galt (2019) showed pH values below the recommended range of 6.5 to 8.5 at most locations. This was correlated with concentrations of total aluminium (one location), total iron (11 locations) and dissolved iron (11 locations) exceeded the adopted criteria, suggesting historical oxidation of ASS and subsequent metal mobilisation has occurred along the Development Envelope (Galt, 2019). Laboratory results in relation to pollutants of potential concern showed all were either below the limit of reporting and/or the adopted assessment criteria. Galt (2019) considered it unlikely that groundwater within the alignment has been impacted by contaminants at concentrations that pose a risk to human health or the environment.

6.6.4 Potential Impacts

Potential direct and indirect impacts to inland waters within the Development Envelope may result from the following project activities:

- Exposure of potential ASS during trenching operations.
- Dewatering of the open trench to allow for a safe construction environment.
- Operation of the wastewater pipeline.

The following impacts have the potential to result from implementation of the Proposal:

- Exposure of ASS resulting in acidification of groundwater and mobilisation of metals or other contaminants within the soil into the water resource.
- Contamination of groundwater through infiltration of untreated dewatering effluent
- Contamination of groundwater resulting from leak of wastewater from the pipeline during operations.

6.6.5 Assessment of Impacts

Exposure of ASS

The variable nature of the sediments comprising the Superficial aquifer provide some level of protection against contaminating materials migrating from the surface to the groundwater resource. Included in these is (GHD, 1997):

- The 'coffee rock' layer, which may adsorb nutrients and metal ions, provide an environment favourable to bacterial destruction and significantly impede downward infiltration.
- The existence of Tamala limestone at the western end of the pipeline route with a capstone and pinnacles on its upper surface. This will assist in neutralisation of groundwater. The formation can retard infiltration and adsorb phosphorus and heavy metals.
- The presence of various thin layers of clay, increasing in thickness and frequency towards the eastern end of the route, would provide some local protection around production bores where they occur.
- Retardation of infiltration provided by the bedding features of the sands forming the Superficial formations.

Dewatering

Dewatering is expected to be required in discrete locations along the Development Envelope. Due to seasonal fluctuations of groundwater, and year to year variations dependent on annual rainfall, it is not possible to definitively identify where dewatering will be required.

Drawdown rates required for the Proposal are currently being investigated; however, it is not anticipated that dewatering will result in significant drawdown in adjacent areas of native vegetation or impact the ability of the nearby water supply bores to extract water from the Superficial aquifer. Additionally, drawdown is expected to be within the normal seasonal variation of groundwater levels. Dewatering in any one location will be temporary and short term, with groundwater levels expected to quickly return to pre-construction levels.

Dewatering effluent discharged without adequate management may impact on groundwater quality. Discharge without retention may cause iron hydroxides to precipitate out or may decrease the local buffering capacity and increase the chance of acidification where buffer levels are already low. Based on these findings of Galt (2019), groundwater abstracted during dewatering will require pH correction using lime injection or similar and that sediment retention ponds be constructed to allow suspended solids to settle out of dewatering effluent prior to re-infiltration into the Superficial aquifer.

Wastewater Pipeline Leaks During Operation

The primary objective of a UWPCA is to ensure good quality safe drinking water is maintained and available. Domestic wastewater can contain several contaminants. **Table 6-13** lists the main contaminant categories and the reason for their importance (GHD, 1997).

Table 6-13 Contaminants in Domestic Wastewater

Contaminants	Reason for Importance
Suspended solids	Suspended solids can lead to the development of sludge deposits and anaerobic conditions when untreated wastewater is discharged in the aquatic environment.
Biodegradable organics	Composed principally of proteins, carbohydrates and fats, organics biodegradable organics are measured most commonly in terms of biochemical oxygen demand and chemical oxygen demand. If discharged untreated to the environment, their biological stabilisation can lead to the depletion of natural oxygen resources and to the development of septic conditions.
Pathogens	Communicable diseases can be transmitted by the pathogenic organisms in wastewater.
Nutrients	Both nitrogen and phosphorus, along with carbon, are essential nutrients for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life. When discharged in excessive amounts on land, they can also lead to the pollution of groundwater.
Priority pollutants	Organic and inorganic compounds selected on the basis of their known or suspected carcinogenicity, mutagenicity, teratogenicity or high acute toxicity. Many of these compounds are found in wastewater, particularly of industrial origin.
Refractory organics	These organics tend to resist conventional methods of wastewater treatment. Typical examples include surfactants, phenols and agricultural pesticides.
Heavy metals	Heavy metals are usually added to wastewater from commercial and industrial activities, although some metals such as copper may have elevated levels due to dissolution of water supply pipework and fittings.
Dissolved inorganics	Inorganic constituents such as calcium, sodium and sulfate are added to the original domestic water supply as a result of water use.

The wastewater pipeline will pass through the wellhead protection zones of the Mirrabooka Wellfield M300 production bores. The M300 production bores abstract Superficial and Leederville aquifer groundwater, which is then conveyed to the Mirrabooka Groundwater Treatment Plant. An undetected leak could potentially impact the groundwater that feeds these bores.

Samples taken from the Beenyup WWTP catchment, an appropriate analogy for Ellenbrook, indicate wastewater is sodium-chloride-bicarbonate type. It is high in ammonia, pathogens, total dissolved solids and organic carbon, which differs from the native superficial groundwater and rainwater quality (Water Corporation, 2020a).

The Mirrabooka Wellfield – Vulnerability and Risk Assessment of Wastewater Pressure Main completed by Water Corporation (2020a) indicates the Superficial bores are at a moderate risk from surface events, including an undetected leak from the wastewater pipeline. Given this vulnerability, velocities through the Superficial aquifer have been estimated to give indicative travel times from a potential leak, to assess pathogen attenuation. For a leak at greater than 130 m from a production bore bacteria and viruses will be adequately attenuated. Anthropogenic contaminants, however, may not be attenuated over this distance (Water Corporation, 2020a).

The M300 bores abstract a limited amount of drinking water, and it is expected that future allocation planning will result in these bores no longer being provided an allocation to extract water from the Superficial aquifer (Water Corporation, 2020a). Should these bores be taken out of service, there is unlikely to be a risk to the drinking water resource in the area of the Development Envelope.

The M200 series bores are located 2 km south of the proposed wastewater pipeline. These bores are not at risk from pathogenic contamination from the proposed wastewater pipeline as this distance will allow for attenuation of pathogens and anthropogenic contaminants (Water Corporation, 2020a). Water Corporation (2020b) reviewed the risk of contamination of the M200 bores from a leak of the proposed wastewater pipeline and concluded that the Proposal is unlikely to have an impact on water quality of the M200 bores as groundwater flow is not directly towards these bores and the time required for a wastewater leak to travel from the pipeline to the M200 bores allows for attenuation of possible contaminates.

6.6.6 Mitigation

The mitigation hierarchy has been implemented throughout the planning and design of the Proposal and will continue to be implemented throughout construction and operation. To reduce the risk of leaks from the wastewater pipeline within the P1 area of the UWPCA, the design has incorporated the following measures:

- The use of dual pipelines instead of a large single pipeline. Dual pipelines allow a reduced pipe diameter, which is easier to maintain and repair and which lowers the likelihood of a leak. Dual pipelines provide flexibility in allowing one pipeline to be taken offline if required for repairs, again reducing the likelihood of a leak. If there was to be a leak, a smaller diameter pipeline means less volume of wastewater lost, reducing the consequence of the leak.
- Remotely operated isolation valves at a maximum distance of 2 km. This will allow for fast isolation of one section of pipe, should a leak be detected, or to undertake maintenance.
- Non-corrosive pipeline material. This increases the reliability of the pipeline, reducing the likelihood of a leak.
- Pipeline material with a high-pressure rating. This will reduce the likelihood of a leak occurring due to the thickness of the pipeline wall and the ability to manage high internal pressure without compromising the integrity of the pipe.
- Fully welded pipe joints. Flexible joints using couplings with a lower specification would normally be applied to a wastewater pipeline. Fully welded joints significantly increase the reliability of the pipeline, reducing the likelihood of a leak.
- Leak detection, including pump flow rate monitoring, pump power monitoring, acoustic leak surveys and visual inspection.

To further minimise and mitigate potential impacts to inland waters, the following management measures, actions and controls are proposed:

- **Avoid**
  - Option 1 is the shortest pipeline route. Avoiding longer routes will reduce the likelihood of a wastewater leak into the UWPCA.
  - The route selection has considered the expected current and future allocated abstraction volume of the M300 and M200 bores. As the M300 bores are expected to be taken out of service after 2028, the pipeline route along Gnangara Road presents a low risk to the drinking water resource.
  - The M300 bores along the pipeline route will not be operated during construction and commissioning of the pipeline. Testing will be undertaken before these bores resume production.
  - Chemical and Fuel storage will be located outside the P1 UWPCA. All refuelling of machinery will also occur outside the P1 UWPCA.
- **Minimise**
  - A Dewatering Management Plan and ASS Management Plan will be developed and implemented. The requirements will include:
    - pH correction using lime injection or similar
    - The use of plastic-lined sediment retention ponds to allow suspended solids to settle out of dewatering effluent prior to re-infiltration into the Superficial aquifer.
  - Limit the length of trench open at any time to approximately 100 m. This is the length of pipe that can be installed in a day. A shorter length of trench requiring dewatering reduces the area of impact and the volume of water required to be disposed or, at any particular point in time.
  - Pipeline will be pressure tested to 1.25 times of maximum allowable operating pressure to confirm the integrity of the pipeline.
  - Specific warning signs will be erected at regular intervals to inform the location of the wastewater pipeline SPM to third parties working in the area that may cause damage.
  - As there is some (low) risk to the superficial bores from an undetected leak from the wastewater pipeline, the Corporation will manage potential events according to *Managing and Responding to Drinking Water Quality Incidents*. The purpose of this procedure is to provide a process for the management and operational response to a raw water *Escherichia coli* (*E. coli*) incident. This includes:
    - Checking operational equipment and settings
    - Use of an alternate water source, if available
    - Increasing the frequency of bacteriological sampling
- **Rehabilitate**
  - Upon completion of works, treatment areas will be appropriately decommissioned, comprising validation, and if required remediation, of the ground surface where the treatment ponds and associated infrastructure were located.

6.6.7 Predicted Outcome

The principal risk in relation to inland waters is contamination of the drinking water resource within the Superficial aquifer of the Gnangara groundwater system, particularly within the P1 area of the UWPCA, where the Water Corporation's drinking water production bores are located.

The groundwater vulnerability assessment undertaken by Water Corporation (2020a) found that bores greater than 130 m from the wastewater pipeline would be at 'no to negligible' risk from leaks from the wastewater pipeline. The bores along Gnangara Road may be at risk of contamination from a leak of the wastewater pipeline; however, current abstraction is 50 ML per year, and it is likely that this allocation will be removed in the future. Should these bores be taken out of service, there are no other nearby bores within the Superficial aquifer that are

likely to be impacted by leaks from the wastewater pipeline. While the bores remain in service, a protocol has been developed to verify the quality of the groundwater abstracted from these bores.

The engineering and design measures put in place for the pipeline, including using non corrosive pipe materials with a high-pressure rating, leak detection, remotely operated isolation valves and contingency options, along with the management measures proposed, further reduce the risk to the drinking water resource and, as a result, the EPA Objective's for this factor will be met.

The wastewater pipeline route along Gnangara Road has been given in-principal support by the DWER Water Source Protection Planning Section (**Appendix A**). Through an analysis of the available options and an a risk assessment of the wellfield, the Proposal represents the lowest risk to the UWPCA, has the least environmental constraints, and is considered safest in terms of traffic management requirements and general access for construction and future operations / emergency response.

6.7 Other Environmental Factors: Social Surroundings

6.7.1 EPA Objective

The EPA's objective for Social Surroundings is 'to protect social surroundings from significant harm'.

6.7.2 Policy and Guidance

The following EPA policies and guidelines have been considered for the proposal in order to meet the EPA's objective in relation to this factor:

- *Statement of Environmental Principles, Factors and Objectives (EPA, 2020).*
- *Environmental Factor Guideline – Social Surroundings (EPA, 2016).*
- *Environmental Protection (Noise) Regulations 1997 (Noise Regulations).*
- *Aboriginal Heritage Act 1972.*

6.7.3 Receiving Environment

The Development Envelope is located in an area zoned as Urban, Parks and Recreation, State Forest, Special Use (telecommunications) with some Rural zoned lots on the northern side of Gnangara Road.

The Development Envelope is located adjacent to Gnangara Road, a main east-west connection between the Mitchell Freeway and Tonkin Highway. As such, the local environment experiences an elevated level of background noise due to high traffic volumes, including heavy vehicles (e.g., freight trucks).

As detailed in Section 1.4, There are no known Aboriginal heritage sites within or adjacent to the Development Envelope. Whiteman Park is adjacent to the Development Envelope at the eastern end. Whiteman Park is listed on the City of Swan's Heritage List but is not listed on the State Register of Heritage Places. No impacts to the values of Whiteman Park are expected due to the small area of disturbance and placement of the wastewater pipeline alignment within previously cleared and disturbed areas.

6.7.4 Potential Impacts

Potential direct and indirect impacts to the Social Surroundings may result from the following project activities:

- Clearing for construction of the wastewater pipeline.
- Trenching, pipelaying and backfilling operations.
- Movement of construction vehicles and machinery around the site.

Potential impacts to the social surrounds of the Development Envelope include

- Dust generated during construction activities blown onto nearby residences and/or businesses creating a nuisance.
- Dust generated during construction activities blown across Gnangara Road creating a safety hazard.
- Noise emissions during construction causing a nuisance to nearby residences and/or businesses.

6.7.5 Assessment of Impacts

There is potential for noise and dust impacts to nearby residences and/or businesses during construction; however, these impacts will be temporary and of short duration. No dust or noise emissions will be generated during the operational phase.

6.7.6 Mitigation

The following measures have been proposed to manage and mitigate the potential impacts to social surroundings:

- Construction noise will be managed in accordance with the Environmental Protection (Noise) Regulations 1997.
- Vehicle speeds within the construction area will be restricted to reduce dust generated by vehicles.
- Construction areas will be managed to reduce dust generation, through the use of water carts or other methods to reduce dust lift-off potential (e.g., hydromulch).
- Disturbed areas will be rehabilitated, and surfaces stabilised following completion of construction.
- Construction activities will be temporarily stopped should there be a visible dust plume likely to cause reduced visibility on Gnangara Road generated from the site. Construction shall recommence once conditions have eased, or additional dust mitigation measures are in place.
- The local community, including nearby residents and businesses will be kept informed of the Proposal and proposed works in the area. Communication will be through the Water Corporation website, newsletters or mailouts, and face-to-face communication where required.
- A complaints management process will be put in place during construction of the Proposal.

6.7.7 Predicted Outcome

Nearby residences and/or businesses may be impacted by noise or dust during construction. Given the short-term duration of construction activities and that ongoing operation of the pipeline will have no ongoing noise or dust emissions, the EPA Objective for this factor will be met.

7. Offsets

As described in the Western Australia environmental offsets guidelines, offsets are 'actions that provide environmental benefits which counterbalance the significant residual environmental impacts of a project or activity' (Government of Western Australia, 2014). Offsets are relevant for significant residual impacts to biodiversity and may include land acquisition and on-ground management, such as revegetation, rehabilitation, or research projects.

An assessment of the potential impacts from the Proposal has been undertaken using the Residual Impact Significance Model outlined in the Western Australia environmental offsets guidelines (**Table 7-1**). Water Corporation does not consider offsets are required due to the lack of potential significant impacts to environmental receptors associated with the Proposal.

Table 7-1: Residual Impact Significance Model

Residual Impact Classification	Flora and Vegetation	Terrestrial Fauna
Residual impacts that are environmentally unacceptable and cannot be offset	None	None
Significant residual impacts that will require an offset	None	None
Potentially significant residual impact that may require an offset	None	None
Residual impacts that are not significant and do not require an offset	▪ Clearing of no more than 0.3 ha of vegetation within the Bassendean Complex – Central and South Complex ▪ Clearing of 0.06 ha of Banksia Woodlands TEC/PEC ▪ Clearing of 0.25 ha within Bush Forever Site 196	▪ Clearing of 2.329 ha of general fauna habitat, of which 0.3 ha is native vegetation. ▪ Clearing of 0.43 ha of foraging habitat for Carnaby's Black Cockatoo Black Cockatoos ▪ Clearing of 0.1 ha of foraging habitat for the Forest Red-tailed Black Cockatoo ▪ Clearing of two potential Black Cockatoo breeding trees (without hollows)

8. Conclusions and Holistic Impact Assessment

This ERD has assessed the potential impacts to the Key Environmental Factors and presents environmental management and mitigation measures to reduce the potential for significant environmental impacts resulting from the Proposal.

Throughout the planning and design of the Proposal, the principles of environmental protection defined in the EP Act have been considered. These are:

- The precautionary principle.
- The principle of intergenerational equity.
- The principle of the conservation of biological diversity and ecological integrity.
- Principles relating to improved valuation, pricing and incentive mechanisms.
- The principle of waste minimisation.

Section 3 provided detail of the options analysis and the assessment process that led to the only feasible wastewater disposal method (a wastewater pipeline) and an alignment with the lowest environmental, economic and social cost. The assessments undertaken show that Option 1, while aligned through the P1 UWPCA, represents the lowest risk to drinking water quality, and comes at a significantly lower environmental cost.

Section 5 details the consultation undertaken by Water Corporation to date, showing an acceptance by key stakeholders that Option 1 represents the most suitable outcome. The key stakeholders have been identified, and Water Corporation will continue to consult throughout the Proposal

Section 6 provides a detailed assessment of the Proposal against the Key Environmental Factors. The key objective for referral to the EPA is the potential to impact the P1 UWPCA; however, all environmental factors have been considered. Water Corporation believes the EPA objectives for the Key Environmental Factors can be met through a combination of impact avoidance and minimisation through the design process, strict and effective environmental management controls implemented during construction, and engineering solutions to mitigate the potential impacts during both construction and ongoing operation of the pipeline.

There are connections and interactions between the Key Environmental Factors considered in this ERD. The interactions relevant to this Proposal are:

- Flora and Vegetation – Terrestrial Fauna interactions

  Clearing of native vegetation reduces the area of fauna habitat and specific components such as habitat trees available for use by terrestrial fauna.

- Flora and Vegetation – Social Surroundings interactions

  Clearing of vegetation may result in increased dust emissions from the Development Envelope.

- Terrestrial Environmental Quality – Inland Waters interactions

  Disturbance of ASS or contamination of soils may in turn contaminate the groundwater resources of the area. While the risk of contamination of the aquifers targeted for Perth's drinking water supply is considered extremely low, the Superficial aquifer is used by local residents (i.e. for gardens).

- Inland Waters – Flora and Vegetation interactions

  Contamination of the Superficial aquifer may impact on the health of the vegetation communities situated above. This could in turn result in changed species composition and vegetation structure within impacted areas.

The management measures and controls proposed for each of the Key Environmental Factors will minimise the impacts resulting from these interactions.

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