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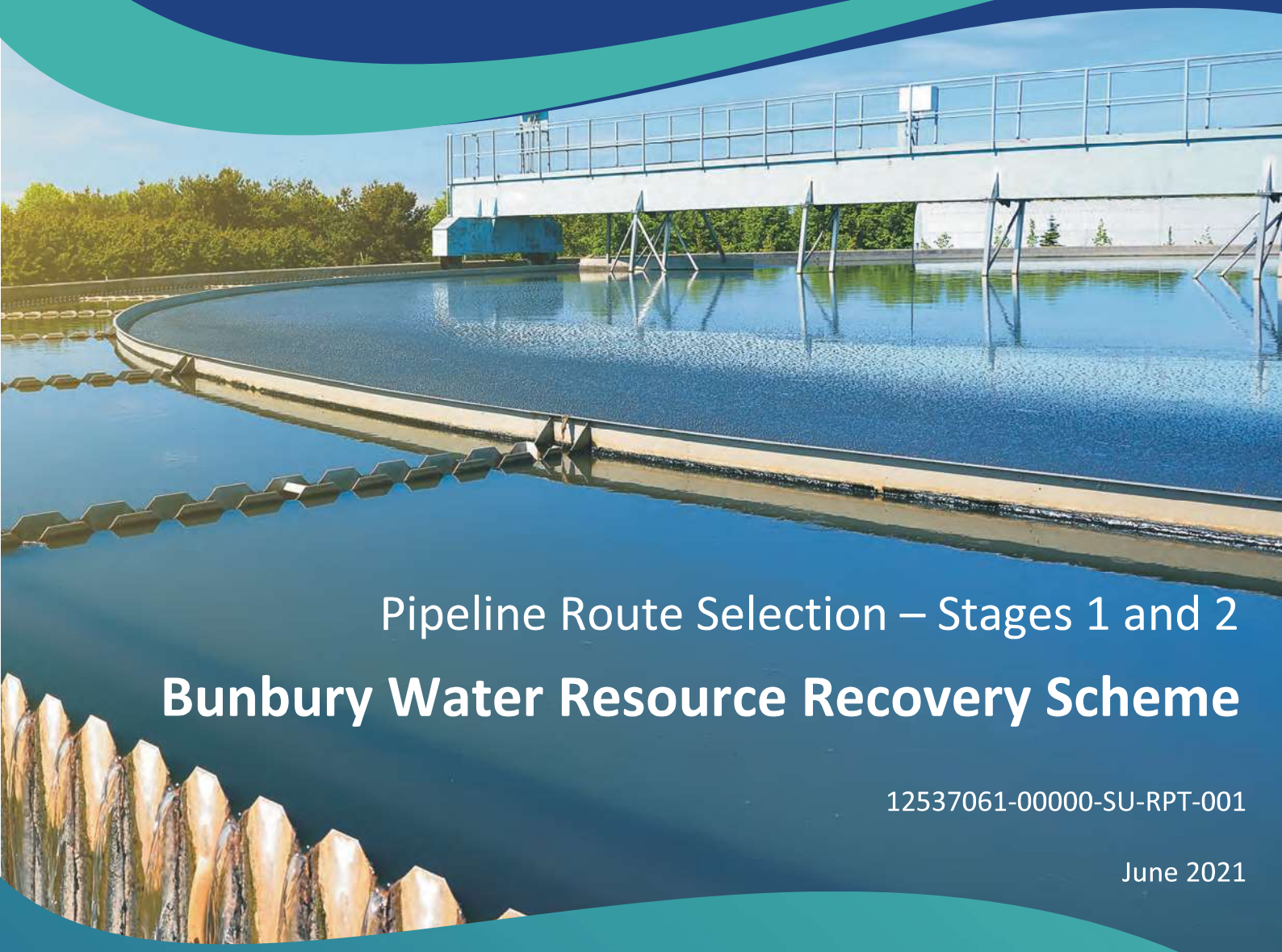

Pipeline Route Selection – Stages 1 and 2

Bunbury Water Resource Recovery Scheme

12537061-00000-SU-RPT-001

June 2021

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1. Introduction

1.1 Background

Aqwest's Water Resource Recovery Scheme (WRRS) project will provide treated wastewater (TWW) for the irrigation of existing public open spaces and for construction water requirements of the Bunbury Outer Ring Road (BORR) project. The source of the water is proposed to be Water Corporation's Bunbury Wastewater Treatment Plant (WWTP). The new Aqwest Recycled Water Treatment Plant (RWTP) will filter and chlorinate the water, which will then be pumped to a header tank. Water will be supplied to customers via gravity pipework and associated infrastructure proposed to be constructed in two stages:

- Stage 1 – Open space irrigation (Hands Oval, Hay Park and Forrest Park) in the City of Bunbury
- Stage 2 – Bunbury Outer Ring Road (BORR) construction water

GHD has been engaged by Aqwest as the Engineering, Procurement, Construction and Management (EPCM) contractor for the new WRRS, including detailed design of the pipeline to distribute TWW to the public open spaces in Bunbury and to the BORR construction site.

The design and construction of Stage 2 has been prioritised by Aqwest over that for Stage 1 in terms of timing.

1.2 Purpose of this report

The purpose of this report is to develop and assess the pipeline route options between the proposed RWTP and the proposed customer supply points, and to document the recommended routes for Stage 1 and Stage 2.

1.3 Scope and limitations

This report: has been prepared by GHD for Aqwest and may only be used and relied on by Aqwest for the purpose agreed between GHD and the Aqwest as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Aqwest arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 2 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Aqwest and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

It should be noted that the content of this document was based on the information collected during this phase of the project. The project team made every attempt to collect a suitable amount of available information relevant to the project in order to minimise the possibility of unforeseen issues arising later. However, the preferred route/alignment and associated works will be subject to approvals from various agencies/authorities and landowners, service locating, surveys, etc. and may be subject to change in the future.

2. Project background and design inputs

2.1 General pipeline route

The general pipeline routes for the two stages were developed early in the project based on supplying water to the proposed customers via the shortest practical route. The general routes are as per the Preliminary Environmental Impact Assessment (PEIA) for the Bunbury Water Resource Recovery Scheme prepared by GHD in 2020 and are shown in the figure below. Stage 1 is shown in blue and Stage 2 is shown in red (including the common section from the header tank to Parade Rd). The pipeline will:

- Start at the RWTP location and run east with a shared Stage 1 and Stage 2 pipeline to meet Parade Rd, where it will split;
- The Stage 1 pipeline will travel north towards Hay Park, Hands Oval and Forrest Park; and
- The Stage 2 pipeline will travel further east to supply BORR.

The routes shown below are indicative only. However, the routes as shown are the premise for the separate report prepared by GHD for the Distribution System Hydraulic Assessment, and any changes from these routes will require review and possible revision of the system hydraulics and associated pipeline sizing.

The routes considered were developed further as the project progressed, as detailed in Section 3.2.

Figure 1: Indicative pipeline routes

2.2 Assumed pipeline details

The specifications proposed for the majority of the new pipework are as follow:

- Modified Polyvinyl Chloride (PVC-M), Rubber Ring Jointed (RRJ);
- Pressure class PN12; and
- Pipe size ranging from DN375 near the RWTP to DN100 at the northern end of Stage 1.

These specifications are based on hydraulic calculations and recommendations made in the separate "Distribution System Hydraulic Assessment" report, which is currently in draft form. As discussed above, any proposed alterations from the original indicative route as shown in the figure above will require review of the hydraulics and the pipeline sizes.

The nominal cover over the pipelines is proposed to be as follows:

- Regional park/reserves – 600 mm;
- Made road reserves/verges/shoulders – 750 mm;
- Road pavement – 750 mm;
- Unmade road reserve – 1000 mm; and
- Other/general/private property – 750 mm.

Open trench excavation is the expected construction method for the majority of the pipeline. Under this method, a trench is excavated for the pipe to be installed within, the trench is then backfilled after the pipe is installed, and the surface is then restored to its original condition. The trench batter slopes adopted during construction will need to be chosen by the contractor for safe work, based on a future geotechnical investigation to be completed for the project and the conditions at the site during construction. The trench may range in width at ground level, depending on the pipe size and subsurface conditions.

Additionally, there are several locations where the pipeline may need to be installed via horizontal directional drilling (HDD), including under major roads, more minor roads, sensitive vegetation, congested areas, etc. For these sections, the pipeline specifications are as follow:

- Polyethylene, PE100, Resistant to Crack & Disinfectants (RCD), striped purple, Butt Fusion Jointed (BFJ);
- Pressure class PN16 (a class higher than the majority of the pipeline to allow for scratches etc. during installation) (final pressure class to be confirmed by the HDD contractor); and
- Diameter that provides the closest internal diameter compared to the PVC pipe in the respective area, taking into account the wall thickness of the PE.

It is anticipated that air valves will be required along the main at all high points and scours at all low points (with the exception perhaps of very deep low points on pipe installed via HDD) to allow emptying and filling of the pipelines.

2.3 Project area overview

The Bunbury WWTP site is within the sand dune area on the coast in the northwest corner of the shire of Dalyellup, just south of Usher. In general, native vegetation dominates the area as well as on land adjacent to a Regional Park.

Much of the land in the Stage 2 project area between the Bunbury WWTP and BORR is bushland and home to several significant flora and fauna and other environmentally sensitive areas.

Of particular significance is BORR itself – which the construction of this pipeline aims to assist with – as the final design for the proposed road is yet to be completed. Without confirmed finished surface levels, pipeline route options in the vicinity of the proposed road carry high risk as any design changes to the BORR, particularly in alignment, will likely have carry-on effects to the design of the Stage 2 pipeline.

The Stage 1 project area north of the Centenary Rd/Parade Rd roundabout is mainly residential and commercial. The majority of this area is of high density.

3. Route selection process overview

3.1 Route selection process

The steps taken in the pipeline route selection process are outlined below. They include:

- Development of route options;
- Constraints study, including data collection, field inspections and stakeholder consultations;
- Rating and comparison of route options; and
- Recommendation of the preferred pipeline route.

Detailed descriptions of the steps taken in the selection process for the pipeline route are included in the following sections.

3.2 Development of route options

Pipeline route options were first identified at a desktop level. The desktop study generally identified the most direct routes and those that avoided the prominent issues/constraints. The route options were further developed through site visits and liaison with external stakeholders such as the City of Bunbury, Department of Biodiversity, Conservation and Attractions (DBCA) and Main Roads WA (MRWA). Aqwest also engaged Geographe Civil for Early Contractor Involvement (ECI) on the pipelines portion of this project, and input from this experienced local contractor was also used to develop potential route options and assess their feasibility.

For the purposes of the route assessment, the pipelines were divided into three main sections:

- From the proposed RWTP to Parade Rd, which is the section shared between Stages 1 and 2;
- The remainder of the Stage 2 pipeline, from Parade Rd to the BORR;
- The remainder of the Stage 1 pipeline, from Parade Rd to Forrest Park (the northernmost supply point).

Plan views showing the pipeline route options considered for this project are attached in the appendices, with numbers assigned to each segment of each route option. These numbers correspond with the numbers in Sections 4, 0 and 0 which detail the route options and assessment for each of the three sections of pipeline.

3.3 Constraints study

The constraints study portion of the route options study focused on data collection. The constraints study for this project took the form of desktop studies, field inspections and stakeholder liaison. The inputs obtained during this phase were used to identify issues, determine any “no go” areas, and compare the route options.

For each route, GHD collected information to inform the assessment process. Existing utility data has been collected from Dial Before You Dig (DBYD) and reviewed to inform construction feasibility and assess constraints and opportunities associated with these routes. Aerial imagery paired with site visits have also assisted in marking features such as large trees and existing drainage structures to inform the desktop development of pipeline route options. However, it is noted that data on existing services is indicative only, and the viability of certain routes and alignments is subject to more accurate service locating and topographical and level survey.

Field inspections took place throughout the route assessment process on an as-needed basis in order to gain insight into particular obstacles and opportunities within the project area. Fieldwork was required to minimise the possibility of an important piece of data being omitted or overlooked, which could have a significant impact on the suitability of the route selection. The inspections also allowed the project team to gain vital familiarity with the project area, which would not have been possible to obtain through a study purely performed at a desktop level. Attendees included various Aqwest and GHD team members as well as personnel from Geographe Civil, and subconsultants specialising in flora and fauna, dieback and aboriginal heritage surveys.

Stakeholders including Aqwest, the City of Bunbury, DBCA, and MRWA were a major source of input to the constraints study, as was advice from ECI contractor Geographe Civil. Significant information was obtained from liaison with personnel from these organisations, which enabled early identification of potential opportunities and constraints for the route options and other issues associated with the project.

3.4 Rating and comparison of route options

After being defined, the route options were compared in detail on the basis of numerous factors including safety, environment, social, economic, constructability and operability. The table on the following pages outlines the various issues associated with each of the route options.

Once the data was collected and reviewed, the route was assessed and a preliminary "rating" category was assigned to each route option investigated. The ratings adopted are as follows:

- Not Viable – unlikely to be viable based on existing/future constraints that have been identified
- Negotiable – may be possible but with major constraints that have been identified
- Manageable – appears viable but with some significant unknowns and/or constraints/ impacts to be managed
- Unrestricted – appears viable with relatively minor/standard constraints/issues to be managed

3.5 Recommendation of the preferred pipeline route

The "traffic light" rating system provides a visual indication of the issues associated with each route and their impacts, and thus allows for a comparative assessment of the options and their viability/difficulty. From the information collected and the ratings, the recommended pipeline route was identified.

3.6 Documentation of the route selection process

Sections 4, 0 and 0 detail the route selection process (including the route options, constraints study, rating and comparison, and recommendation of the preferred route) for each of the three sections of pipeline, respectively:

- From the proposed RWTP to Parade Rd (the section shared between Stages 1 and 2);
- The remainder of the Stage 2 pipeline, from Parade Rd to the BORR; and
- The remainder of the Stage 1 pipeline, from Parade Rd to Forrest Park.

4. Route assessment – RWTP to Parade Rd (section shared by Stages 1 & 2)

4.1 Route option details and ratings

As discussed above, several route options were identified and assessed for the section of pipeline between the RWTP header tank and Parade Rd, which will be shared by Stages 1 and 2. The routes were divided into several segments, which are numbered on the map in Appendix A and correspond to the numbering of the below sections describing the conditions and issues.

1. Bunbury WWTP lagoon access track

The starting point of the pipeline is at the proposed header tank at the RWTP site. There is an access track to the Water Corporation's WWTP lagoons in this area, which runs off the WWTP sealed access road. The surrounding environment is scrubland on sand dunes. In addition to the recycled water supply main, other services will be installed in this area to/from the RWTP, including (but not necessarily limited to) power and potable water. The intention is for the pipeline (and other services) to follow the existing access track as much as possible to minimise clearing. A preliminary sketch showing the proposed header tank location and proposed pipeline location is shown in Figure 2.

This section of the pipeline appears suitable in terms of constructability. Ideally, all the proposed new services will be installed at the same time to maximise efficiency and minimise impacts on the access road/traffic. Whether these services are constructed together or in stages, traffic management will be an issue. Water Corporation access along this track may need to be retained throughout construction. Similarly, access for RWTP construction vehicles, machinery and plant is also likely to be required during pipeline installation.

Another issue is clearing alongside the track to allow installation of the required services as well as continued access. The predominant native vegetation along the access track is low open woodlands over medium height woodland, where *Agonis flexuosa* (peppermint tree) is the dominant species. There were no recorded occurrences of Western Ringtail Possums (WRP) along this access track. This project aims to 'Avoid' clearing native vegetation in this location by locating the majority of the disturbance works in the already cleared road corridor.

This route appears viable but with impacts on the environment to be carefully managed, and it is therefore assigned a "manageable" rating.

Note that there are no other route options identified for this section of the pipeline, given that significant clearing would be required for any other alternatives (there are no other cleared tracks/firebreaks), and minimising clearing is a key objective for the project.

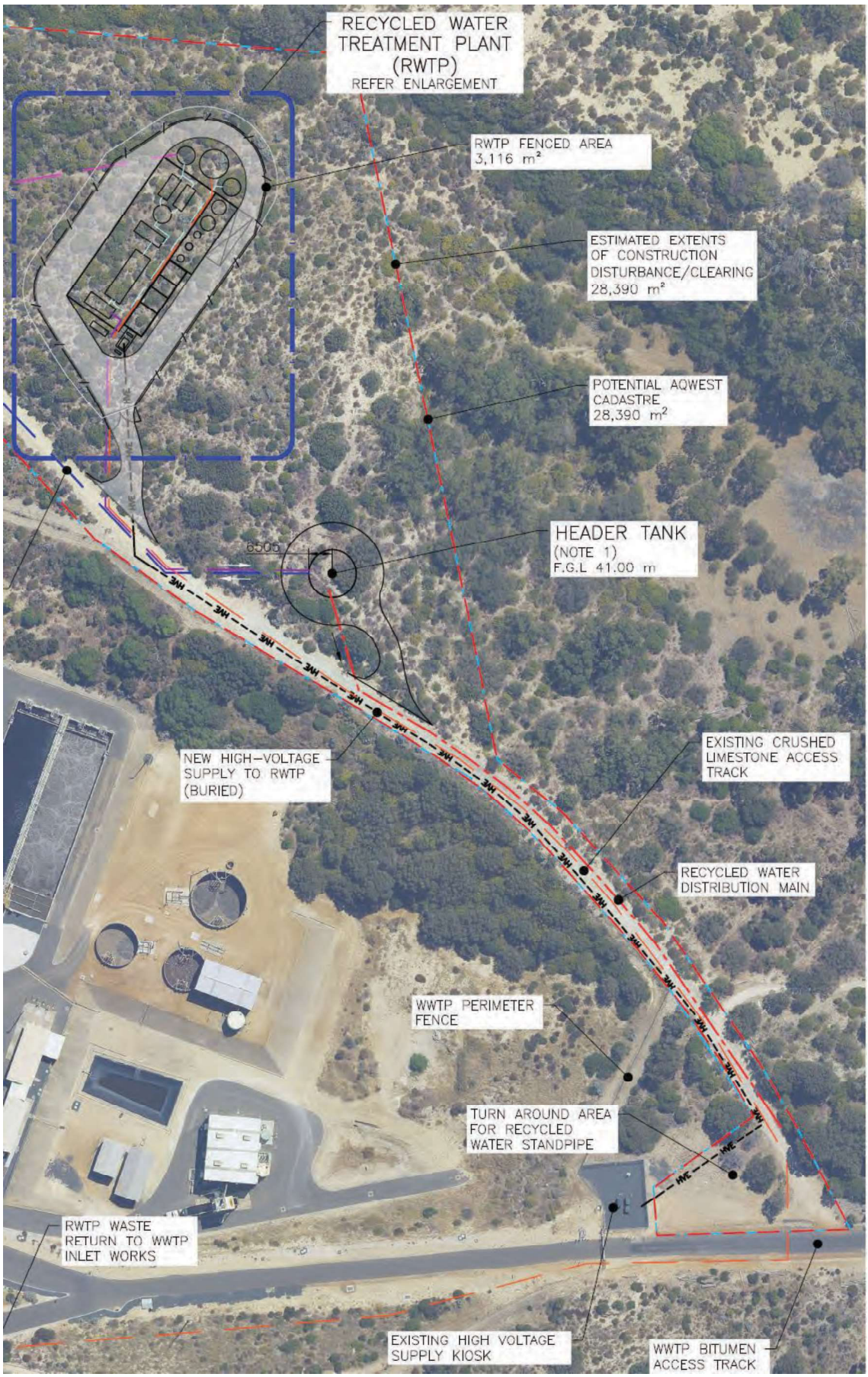

Figure 2: Preliminary RWTP layout – proposed header tank and supply main location

2. Firebreak running east through Regional Park to Ocean Dr

Partway along the WWTP lagoon access track, there is a bifurcation to a firebreak just north of the sealed access road for the Bunbury WWTP (shown in Figure 3). This route options follows the firebreak east through the Regional Park.

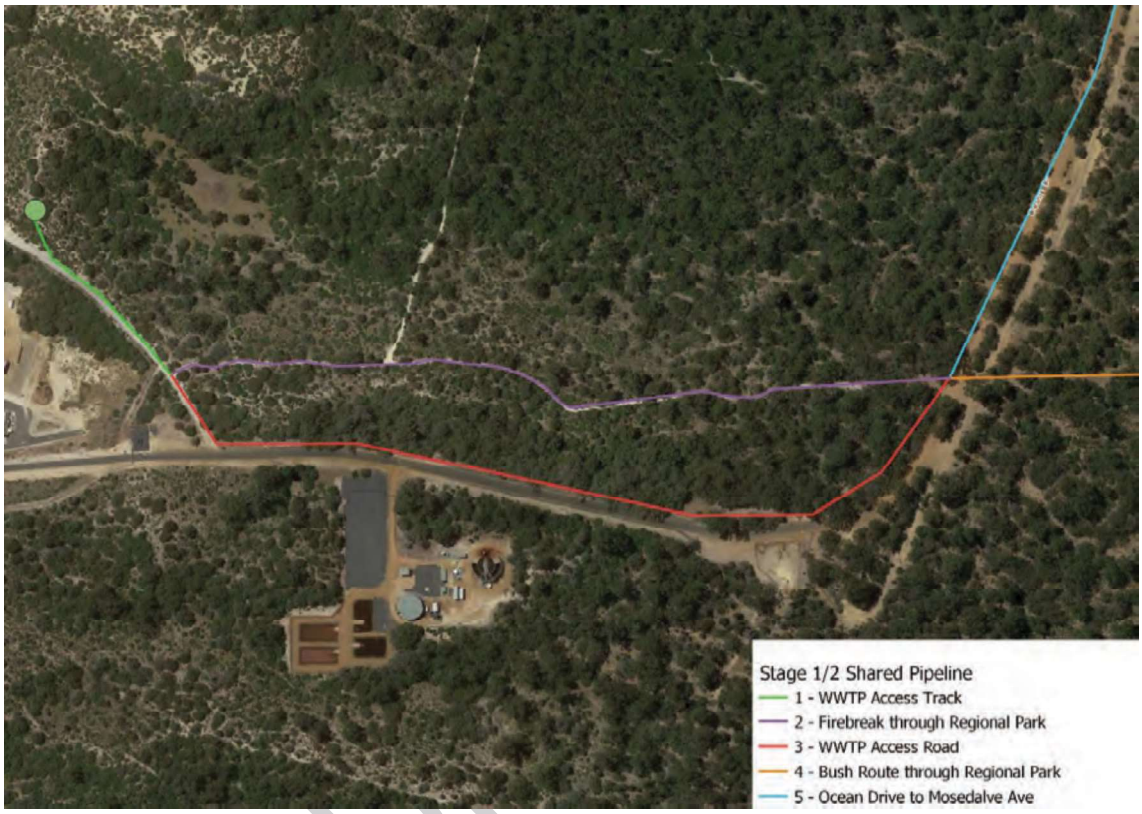

Figure 3: Route options in the vicinity of the RWTP

Portions of several pipeline route options either pass through or are adjacent to the Preston River to Ocean Regional Park (PRORP). The Park has not been formally gazetted; however, the land has been reserved under the Greater Bunbury Region Scheme (GBRS) and some land parcels are managed by DBCA under a Memorandum of Understanding with the City of Bunbury. The Regional Park comprises areas with significant conservation and landscape values, together with existing recreation amenities. Land parcels scheduled for inclusion in the Regional Park are shown in Figure 4.

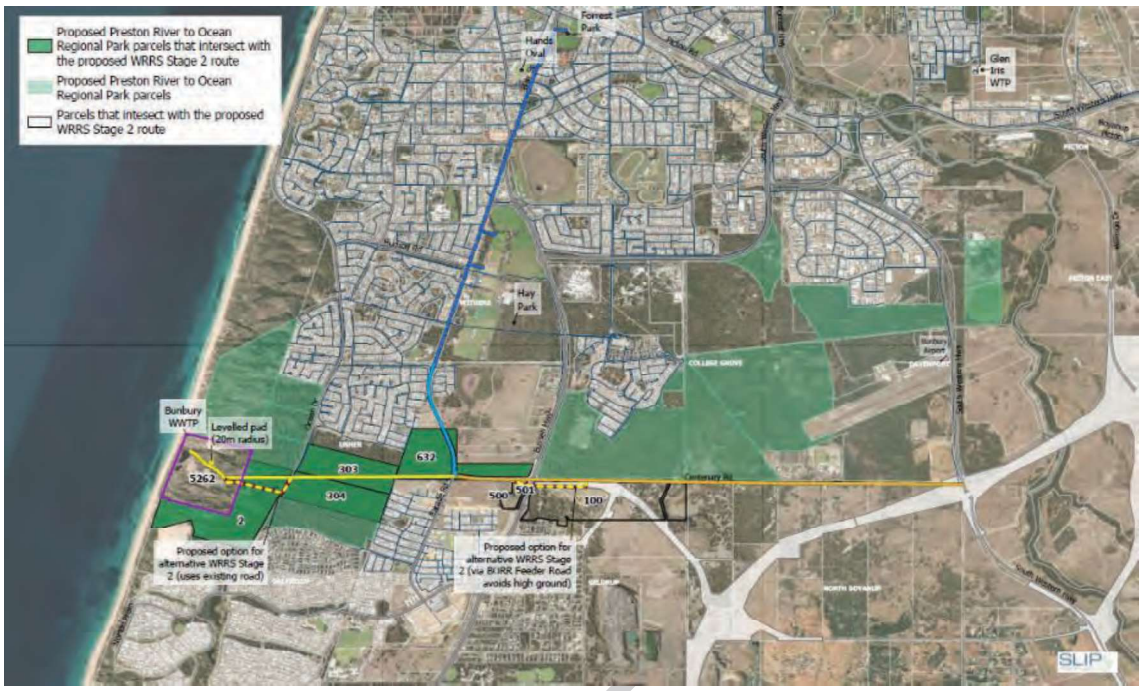

Figure 4: Proposed Regional Park land parcels (from PEIA document)

The native vegetation mapped in this area is *Eucalyptus gomphocephala woodland* Priority 3 community. This vegetation type is associated with the EPBC Tuart Threatened Ecological Community (TEC) and is generally in 'Very Good' condition. There is some evidence of WRP in this area. Every effort to avoid clearing of native vegetation and associated fauna habitat will be made in this section of the alignment.

The track/firebreak followed by this route option through the Regional Park is approximately 3-5 m wide and appears to contain no existing services. The track itself is relatively flat in cross-section, though the land directly adjacent to the north slopes down steeply, and the area to the south slopes less steeply up. Earthworks would therefore be required on the south side of the track to construct a reasonably level platform for pipeline construction. Geographe Civil has indicated that an overall corridor width (including the track) of approximately 10 m is required, although individual trees within the 10 m corridor may be able to be retained depending on their location within the corridor. Understory within this corridor would need to be removed. The track is winding in a horizontal direction and undulating in the vertical, further complicating construction access and the required earthworks (though not impacting the hydraulics). It is particularly steep in the section just west of the Tuart Walk Trail, and HDD may be necessary in this area.

Figure 5: Firebreak east of WWTP site through Regional Park

Geographe Civil has indicated that this route has more constructability issues than Option 3 (the WWTP access road). Most notably, access is limited along the firebreak, and relatively extensive earthworks are required to prepare the area for pipeline construction. The track itself is undulating, further complicating the earthworks required.

There is potential to reduce the impacts to the environment by using HDD technology for installation of the pipeline along this path. However, some clearing would still be required to allow access for the HDD equipment as well as welding/stringing out of the PE pipe. The costs of this type of installation would most likely be significant compared to conventional open trenching.

This option avoids existing services and traffic; however, it has significant environmental impacts and early indications are that it is not preferred by key external stakeholder DBCA. It is also not preferred in terms of constructability. It is therefore considered viable but with significant constraints and is categorised as “negotiable”.

3. Bunbury WWTP access road to Ocean Dr

An alternate to route option 2 is to continue following the WWTP lagoon access track south to the WWTP access road and then following the access road east to Ocean Dr (shown as the red line in Figure 3 and Appendix A). Based on DBYD data and site visits, there are multiple existing services along this road, including wastewater, potable water and underground and overhead power. There are also rock pitched open drains in the verges in the steep section of road leading to the WWTP. Service locating would be required to determine the exact location of underground services and their alignments, and a viable alignment for the recycled water supply main. The verges are narrow, with native vegetation on both sides.

Figure 6: WWTP access road, facing west

This route is constrained on environmental grounds as it includes both the Tuart TEC woodland and occurrence of WRP. Trees with the potential of providing Black Cockatoo (BC) breeding and foraging habitat were also mapped along this corridor. Clearing of native vegetation along this section of the project would require referral of the project to the Department of Agriculture Water and the Environment (DAWE) under the EPBC Act and would likely be assessed as a Controlled Action.

Due to the existing overhead power line in the southern verge (which presents a safety issue during pipeline construction and future maintenance) and the expected presence of services under the road pavement, the most likely location for the proposed pipeline is in the northern verge. Some vegetation clearing is very likely to be required. However, initial discussions with DBCA indicate that clearing along the already-disturbed area of the paved road is preferable to clearing along the firebreak of route option 2.

Traffic management will be an issue for this route, as Water Corporation access to the WWTP will be required throughout pipeline construction. In addition, it is likely that unobstructed access for RWTP construction vehicles by the separate contractor will also be required. However, the advantage of constructing along the access road is that there is readymade access for the pipeline contractor.

Aqwest personnel have indicated that they would accept installation of the pipe underneath the open drain, where it is unlikely that existing services are located. This alignment would help to limit vegetation clearing in the northern verge. However, even with this option, the rock drain does not extend along the full length of the route, and the issue of the narrow corridor persists east of the drain, with several utilities on both sides of and under the road and limited clear verge width.

From a constructability perspective, Geographe Civil has indicated that the WWTP access road provides much better access for construction and will be more cost effective to construct (compared to Option 2).

This option cannot be confidently scored given the unknown locations of existing services and thus the uncertainty in alignments available for the proposed pipeline and the amount of vegetation to be cleared. However, based on the initial discussion with DBCA, which indicated that clearing along this route would be possible and preferred over clearing along the firebreak in route option 2 (even if more vegetation is required to be cleared along the road due to other constraints), and the fact that constructability/access is considered high by the experienced contractor, a preliminary rating of "manageable" is assigned to this option. To confirm the impacts of this route, service locating should be undertaken, as well as further consultations with DBCA regarding environmental impacts and Water Corporation regarding traffic management.

Figure 7: Track through Regional Park looking east from near Ocean Dr

4. East from Ocean Dr through Regional Park

This option starts where options 2 and 3 end on Ocean Dr and continues running east through the Regional Park. Similar to option 2, this option avoids existing services and there does not appear to be any planned development along this path. However, it has similar access constraints to option 2, and similar environmental impacts, which DBCA has indicated are not favourable.

There are a number of environmental values along this corridor, including the Tuart TEC and potential WRP and BC foraging and breeding habitat.

The cleared corridor appears to be narrower than further west along route option 2, and thus more vegetation clearing may be required to obtain an appropriate construction corridor.

For reasons similar to option 2, this option is categorised as "negotiable". It minimises impacts to traffic and avoids other services. However, it has significant environmental impacts and is not preferred by DBCA, nor by Geographe Civil due to access constraints

5. Ocean Dr running north and Mosedale Ave running east

As an alternative to option 4, the pipeline could run north along Ocean Dr and turn east on Mosedale Ave, travelling along the residential road. This option avoids bisecting the Regional Park by utilising the Water Corporation Bunbury WWTP access road and residential roads.

This option has not been subject to a detailed site visit, but has been assessed from a desktop level.

There are existing services along both Ocean Dr and Mosedale Ave, including two large diameter sewer pressure mains. Potholing to locate these services will be required as these mains are critical for wastewater services to the City of Bunbury and run to the Bunbury WWTP. Subject to clearances from other utilities, the main may run in the road or in the adjacent road verge; there appears to be a reasonably wide verge along the edge of the subdivisions, and environmental issues may be more easily managed. In fact, initial discussions with DBCA indicate that this route is highly preferable to option 4, even if more vegetation clearing is required, as it is around the (disturbed) fringes of the bushland and therefore wont impact the environmental corridor. While the native vegetation mapped in this area is the listed Commonwealth listed Tuart TEC, there is increased scope along this section of the corridor to 'Avoid' clearing of native vegetation due to the width of the cleared area adjacent to the vegetation. The location of this route along the edge of the bushland also reduces any potential impact clearing for the pipeline may have in terms of its connectivity value for fauna

It is noted that this route option adds additional length to the overall pipeline, however is more viable from a construction perspective due to accessibility. It is also more viable from an environmental approvals perspective.

This option is similar to option 2 in that it cannot be confidently scored given the unknown locations of existing services and thus the uncertainty in alignments available for the proposed pipeline and the amount of vegetation to be cleared. However, based on the initial discussion with DBCA, and the fact that constructability/access is considered high by the experienced contractor, a preliminary rating of "manageable" is assigned to this option. To confirm the impacts of this route, service locating should be undertaken, as well as further consultations with DBCA regarding environmental impacts.

6. Mosedale Ave running north and Parade Rd running south

From the end of route option 5, option 6 continues to run north along Mosedale Ave, then cuts east across to Parade Rd.

Along this section of Mosedale Ave running roughly north-south, the cleared verges appear to be narrower than for option 5, which may present challenges with achieving acceptable clearances from the large diameter sewer pressure main and other utilities that run parallel. No photographs are available for the Mosedale Ave section, as this option was a late addition to the route assessment and has not yet been visited on a detailed site visit. However, desktop information has been viewed.

This route must cut through property between Mosedale Ave and Parade Rd, along the boundary in either the private property that appears planned for subdivision or just within the Regional Park. Further liaison with the appropriate stakeholders will be required to determine the most suitable location for the pipeline. Initial indications from DBCA are that it may be possible to locate the pipeline just within the northern boundary of the Regional Park, particularly if it means avoided clearing/locating the pipeline through the middle of the bush as for option 4. Every effort will be made to 'Avoid' clearing native vegetation along this section of the corridor as the native vegetation mapped in this area is recorded as the Tuart TEC.

Once reaching Parade Rd, the shared pipeline then splits, with Stage 1 travelling north and Stage 2 running further south along Parade Rd to Centenary Rd. This route would serve to shorten the length of pipe required for Stage 1 but lengthen the pipe required for Stage 2 (which is a larger diameter). It is noted that taking these detours to avoid bushland will result in the addition of approximately 500 m of DN375 pipe to the overall combined length required for Stage 1 and 2 pipelines, which will add significant cost to the project (refer to Table 2).

After the Stage 1 & 2 bifurcation, the pipeline will likely be located along the east side of Parade Rd due to the existing services in the western verge. There are a several points where drainage structures are located to divert stormwater away from the road and these will need to be managed appropriately. Traffic management will also need to be considered. Some vegetation clearing may be required, though this will be limited as much as practical.

Figure 8: Eastern verge of Parade Rd facing south from near Crampton Ave

The main issues associated with this route are clearing and pipeline length/cost. However, DBCA has indicated that clearing may be acceptable along this route, and the additional cost is considered relatively minor compared to the overall cost of the project. Other issues and constraints such as traffic management, services, etc. are considered manageable and are applicable to most pipeline projects. This route is thus categorised as “manageable”, pending further site investigations and stakeholder liaison.

7. Firebreak from Mosedale Ave running south

This option allows tying back into the east-west bush route from the eastern end of route option 5. This route was not walked on site, but like route option 4, is expected to have no issues with existing services, as there appear to be no other utilities along this route.

This section of vegetation predominately comprises the Tuart TEC and while not mapped, the vegetation is likely to support WRP and Black Cockatoo breeding and foraging habitat. Every effort to minimise the clearing footprint is important along this section of the route.

Construction access will be an issue, and it is anticipated that Geographe Civil will consider the difficulties associated with this route to be similar to those for options 2 and 4.

Given its similarities to routes 2 and 4, this option is categorised as “negotiable”. However, it is noted that it may be preferred by DBCA in terms of environmental impacts over options 2 and 4, if it avoids those two options. It also is a shorter length and thus likely requires a lesser amount of clearing.

8. Due east to Parade Rd/Centenary Rd Roundabout –

This option starts at the eastern end of options 4 and 7 and travels east to the Parade Rd/Centenary Rd roundabout (finishing at the same location as option 6).

The vegetation communities along this strip of the corridor is a combination of cleared areas to accommodate roads and tracks with some patches of *Eucalyptus rudis* (Flooded gum), *Melaleuca rhaphiophylla* (paperbark) and *A. flexuosa*. WRP were not observed in this section of the corridor, however a number of potential breeding and foraging trees were mapped in this section. In addition to the mapped environmental values, DBCA advised that the ‘thin strip’ of vegetation in this section is very important as it is the only connection between the larger extents of native vegetation established either side and is therefore an important area to protect in order to maintain connectivity and integrity of the Preston to Ocean Regional Park.

It may be possible to avoid impacting the native vegetation along this route by locating the pipe in the new subdivision to the south of the boundary. It appears that this Shire of Capel subdivision will include a service road in this area, and installing the pipeline within this service road would not impact any lots. There is an existing large open drain which would likely need to be crossed at some point depending on the alignment; however, this is likely to be manageable. Collected DBYD data suggests that there are proposed services yet to be installed for this area, so it will be critical to liaise with other utilities, the developers and the shire(s) to ensure clashes are managed and appropriate clearances are achieved. However, this alignment offers the benefit of avoiding clearing of sensitive vegetation.

Assuming that the alignment within the new subdivision is viable, this option is categorised as “unrestricted”. Further liaison with stakeholders is required to confirm.

Figure 9: Track within bush block on the northern side of this route, facing west

Figure 10: Service road along northern edge of subdivision on the southern side of this route, facing west

9. Ocean Dr running north and Washington Ave running east to Parade Rd

This option was a late addition to the assessment process and was suggested by Aqwest based on a potential alternative alignment for the Stage 2 pipeline, as discussed later in Section 0. The route starts at the gate to the WWTP access road on Ocean Dr and runs north up Ocean Dr, then turns east to run along Washington Ave. This route was not subject to an in-depth site visit but was viewed at a desktop level.

As this route exclusively follows existing subdivision roads, access for construction will be acceptable. However, there will be more constraints than along the southern portion of Ocean Dr/WWTP access track, as construction in this area will be in close proximity to houses, traffic and other interfaces with the public will need to be carefully managed. Washington Ave in particular appears to be a main thoroughfare within the subdivision, and construction in this road reserve will result in larger impacts on residents. Removal of any verge vegetation is unlikely to be favourable to local residences.

Clearances from existing services and other features such as trees will be a major constraint along this route. A large diameter sewer pressure main to Bunbury WWTP runs parallel to Ocean Dr in the eastern verge, along with overhead power lines and other services. It is unlikely

that the pipe can be laid in the same verge while achieving appropriate clearances due to the presence of many trees along this route option. The western verge also contains a sewer pressure main and sewer pump station on Ocean Dr, and while wider also contains many trees along its length. Preliminary DBYD data along Washington Ave indicates that there are several services on the northern verge, however this data is incomplete as this route option was a late addition. The issue of trees persists along the full length of the southern verge, and laying the pipe will very likely require a lane closure along Washington Ave.

Some environmental values were mapped along this alignment, however with the intent to locate the pipe within the existing road reserve, it is very unlikely that environmental approvals along this section of the route would be required.

Due to the constrains associated with existing services and impacts on local roads and residences compared to other options, this is categorised as “negotiable”. It is also worth noting that the viability of this route largely depends on the preferred route for the remainder of the Stage 2 pipeline.

4.2 Route option comparison

4.2.1 Overall options comparison

The traffic light map in Appendix B illustrates the ratings assigned to each route as detailed in the sections above. The map allows for readers to make a visual assessment of the combined opportunities and constraints associated with each route option, and the viability of one option compared to another.

Based on the issues outlined in this report, a comparison table was developed for the options assessed. The table outlines the constraints and opportunities associated with each option. It uses the colour coding previously adopted to further break down the issues and allow visual analysation and comparison. The table is located on the following page.

Table 1: Route option comparison summary – shared Stage 1 and 2 (WWTP to Parade Rd)

Option		Issues					
		Environmental	Social/Stakeholders	Constructabilitly	Operability	Time	Overall rating
1	Bunbury WWTP Lagoon Access Track	Clearing permit required. Manageable approval process	Access for WC vehicles will need to be maintained	Reasonable access along existing well-formed track	Expected ease of access in the future along upgraded track to RWTP	Impacts of required approvals on project timeline expected to be minimal based on early DBCA advice	**Manageable** (Note: to be reviewed once additional services data and WC input is confirmed)
2	Firebreak running east through Regional Park to Ocean Dr	Impacts MNES and native vegetation. High environmental values to be managed during design phase	Little impact on traffic or other stakeholders. Impact on tuart walk trail to be minimised	Issues with access and topography result in constructability issues along this route	Future access to pipeline could be difficult unless the track is properly maintained, creating additional O&M work for Aqwest. Concerns re: PVC RRJs near tree roots	Could have significant impacts on project timeline, particularly for environmental approvals	**Negotiable**
3	Bunbury WWTP access road to Ocean Dr	Impacts MNES and native vegetation. High environmental values to be managed during design phase	Access for WC vehicles will need to be maintained	Access and topography along this option are preferable	Expected ease of access in the future due to existing adjacent paved road	Impacts of required approvals on project timeline expected to be minimal based on early DBCA advice	**Manageable**
4	East from Ocean Dr through Regional Park	Impacts MNES and native vegetation. High environmental values to be managed during design phase	Little impact on traffic or other stakeholders	Issues with access and topography result in constructability issues along this route	Future access to pipeline could be difficult unless the track is properly maintained, creating additional O&M work for Aqwest Concerns re: PVC RRJs near tree roots	Could have significant impacts on project timeline, particularly for environmental approvals	**Negotiable**
5	Ocean Dr running north and Mosedale Ave running east	MNES and native vegetation in this section however, will be mostly avoided with construction to occur in existing reserve	Local traffic and residences impacted, but impacts may be minimised if alignment can remain along the edge of the Regional Park	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future due to existing adjacent track/road, though traffic management may be required	Impacts of required approvals on project timeline expected to be minimal based on early DBCA advice	**Manageable**
6	Mosedale Ave running north and Parade Rd running south	MNES and native vegetation in this section however, will be mostly avoided with construction to occur in existing reserve	Local traffic and residences impacted, but impacts may be minimised if traffic movements can be largely maintained	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future due to existing adjacent roads, though traffic management would be required	Impacts of required approvals on project timeline expected to be minimal based on early DBCA advice	**Manageable**
7	Firebreak from Mosedale Ave running south	Impacts MNES and native vegetation. High environmental values to be managed during design phase	Little impact on traffic or other stakeholders	Issues with access result in constructability issues along this route	Future access to pipeline could be difficult unless the track is properly maintained, creating additional O&M work for Aqwest. Concerns re: PVC RRJs near tree roots	Could have significant impacts on project timeline, particularly for environmental approvals	**Negotiable**
8	Due east to Parade Rd/ Centenary Rd roundabout	The thin strip of native vegetation along this section is an important link for the Preston to Ocean Regional Park. Clearing of native vegetation is mostly avoided	Expected to have little impact on the public or other stakeholders if located along the northern boundary of the subdivision	Access and topography along this option are preferable, assuming an alignment along the northern end of the subdivision	Expected ease of access in the future due to existing adjacent service road	Impacts of required approvals on project timeline expected to be minimal as long as vegetation clearing is avoided	**Unrestricted**
9	Ocean Dr running north and Washington Ave running east to Parade Rd	Minimal impact to native vegetation and MNES with construction planned to occur within the existing road reserve	Substantial impacts on the public/local residences/traffic in Usher	Congestion of existing services and verge trees is a concern. High level of traffic management required. Safety issues due to congested corridor.	Extensive traffic management likely required for future access	Impacts of required approvals on project timeline expected to be minimal; however, construction time could be longer than other options due to pipe length and construction efficiencies due to the issues to be managed and the restoration required	**Negotiable**

4.2.2 Route option lengths/costs

The indicative lengths and costs for each route option are listed below. Costs have been estimated based on an average rate ([redacted]) for the supply and laying of DN375 PVC-M pipe. The costs listed below do not take into account adverse ground conditions such as rock, dewatering, etc. nor do they allow for any HDD sections. The indicative costs are intended for high level comparison based on length only.

Table 2: Route option length and cost summary – shared Stage 1 and 2 (WWTP to Parade Rd)

Route option		Approx. length	Indicative cost
1	Bunbury WWTP lagoon access track	160 m	[redacted]
2	Firebreak running east through Regional Park to Ocean Dr	620 m	
3	Bunbury WWTP access road to Ocean Dr	680 m	
4	East from Ocean Dr through Regional Park	950 m	
5	Ocean Dr running north and Mosedale Ave running east	1,440 m	
6	Mosedale Ave running north and Parade Rd running south	1,050 m	
7	Firebreak from Mosedale Ave running south	290 m	
8	Due east to Parade Rd/ Centenary Rd roundabout	610 m	
9	Ocean Dr running north and Washington Ave running east to Parade Rd	1,600 m	

Comparing the route option lengths individually does not help assess the overall length of each combination. There are a total of ten possible routes considered for the shared pipeline section as summarised in the following table.

Table 3: Possible pipeline routes for section shared between Stages 1 and 2 (WWTP to Parade Rd)

Pipeline route		Total length	Total cost
A	1 – 2 – 4 – 8	2,340 m	[redacted]
B	1 – 3 – 4 – 8	2,400 m	
C	1 – 2 – 4 – 7 – 6	3,070 m	
D	1 – 3 – 4 – 7 – 6	3,130 m	
E	1 – 2 – 5 – 6	3,270 m	
F	1 – 3 – 5 – 6	3,330 m	

Pipeline route		Total length	Total cost
G	1 – 2 – 5 – 7 – 8	3,120 m	[redacted]
H	1 – 3 – 5 – 7 – 8	3,180 m	
I	1 – 2 – 5 – 9	2,950 m	
J	1 – 3 – 5 – 9	3,010 m	

Note that for pipeline routes options I and J, only part of route option 5 (the first 570 m along Ocean Dr leading to Bunbury WWTP) is used before transitioning to route option 9. This has been considered in the total length and cost calculations for these pipeline routes.

As shown in the table above, the possible pipeline routes are similar in length and cost. However, there is an approximate 30% difference between the shortest route (A) and the longest route (F), with an estimated cost difference of [redacted] Refer to the following section for further discussion regarding the route option comparison.

4.2.3 Comparison summary

The main constraints in the project area affecting the pipeline route options include areas of high environmental value, existing services, future infrastructure and residential developments, and existing subdivisions/businesses/residences, and the constructability and operability issues that these impacts create. None of the route options explored for the section of shared pipeline for Stages 1 and 2 however were identified as being completely unviable for construction of the pipeline based on information at hand at this stage. Similarly, none were found to be completed unhindered.

As discussed in the sections above and shown on the traffic light map in Appendix B, there is one route option combination in which all of the segments are considered “manageable”. Shown as option F, this route starts at the header tank, follows the WWTP lagoon access track (option 1), then runs east along the WWTP paved access road (option 3), turns north and runs up Ocean Dr before turning east and running along Mosedale Ave (option 5), then runs north and east along the edges of the Regional Park before running south along Parade Rd to Centenary Rd (option 6). All of the other route combinations include at least one section identified as “negotiable”, which could negatively impact this important project and its delivery schedule.

This option does result in the longest length and thus potentially the highest cost. However, while an estimated 30% difference is not negligible, it is worth noting that the cost associated with additional pipe length could be offset by other factors such as savings on project timeline, costs for rock excavation, costs for HDD sections, pipelaying efficiencies due to available construction corridor, savings on general earthworks, etc., which were not quantified as part of this high level cost comparison. Also, cost, while important, is not seen a key driver on this project when compared to other factors such as schedule, environmental impact and constructability.

4.3 Recommended pipeline route

As a result of the assessment undertaken, the route identified as Option F appears the most viable in terms of environmental, social/stakeholder, constructability, operability and project timeline factors compared to the other options, and is recommended as the preferred route.

This recommendation is based on the information obtained to date. It is recommended that further information gathering and consultation with authorities/stakeholders be undertaken to confirm the viability of this route, as outlined in Section 4.4 below.

The key obstacles for the pipeline portion of this project are expected to be authority approvals (particularly those required from DBCA and Water Corporation), minimising vegetation clearing and other environmental impacts, managing impacts on local residents and road users (including managing safety), undertaking major road crossings, construction near existing services (including safety impacts) and delivering water to customers for the new recycled water scheme on time.

4.4 Further recommended action

The recommended actions to confirm the preferred pipeline route option and its viability and to progress the pipeline design include:

- Consult with Water Corporation regarding the acceptability of the proposed pipeline route along the WWTP lagoon access track and the WWTP access road/Ocean Dr;
- Undertake service locating in key locations (particularly along the WWTP access road) to determine a viable alignment for the new pipeline;
- Continue liaison with DBCA and other authorities in regards to the proposed clearing and managing environmental impacts;
- Liaise with the City of Bunbury regarding construction along shire roads and issues such as reinstatement requirements and limiting impacts to residents;
- Instigate other site investigation work such as topographical and feature surveys, geotechnical investigations, etc. along the proposed route;
- Once survey and services data is obtained, set the pipeline alignment and identify the proposed construction corridor (to allow environmental applications to be submitted in a timely manner); and
- Request to authorities that any future proposals by others along the proposed route be made known to Aqwest for discussion prior to implementation. This is particularly applicable to where the pipe runs in road reserves, where land rights cannot be obtained/the route cannot otherwise be secured prior to construction.

5. Route assessment – Parade Rd to BORR (remainder of Stage 2)

5.1 Route option details and ratings

As discussed in Section 3, several route options were identified and assessed for the section of pipeline between Parade Rd and BORR, which is exclusively Stage 2. The routes were divided into several segments, which are numbered on the map in Appendix C and correspond to the numbering of the below sections describing the associated conditions and issues.

10. Washington Ave and Aqwest Pipeline Reserve through bushland to South Western Hwy

This option was a late addition to the assessment process and was suggested by Aqwest as a potential alternative for the Stage 2 pipeline. The route continues from the eastern end of route option 9 and runs east along Washington Ave, then turns north up Bussell Hwy for a short distance before turning east and running along the northern boundary of a residential area, then travelling northeast within an Aqwest pipeline reserve through bushland to South Western Hwy. The BORR constructors could either locate storage in this area (and cart it to the BORR project area), or continue to run the pipeline down South Western Hwy to Centenary Rd. This route was not subject to an in-depth site visit but was viewed at a desktop level and considered at a high level.

Preliminary advice from DBCA dated 30 March 2021 has deemed this route option east of Somerville Dr as unsuitable in terms of environmental impacts, where the alignment occurs along from Sommerville Drive to South West highway. While there is an Aqwest reserve through the middle of the Regional Park, this alignment passes through high quality Banksia TEC woodlands, wetlands and other threatened flora and fauna habitat. Construction of the pipeline within the Aqwest reserve has the potential to fragment what is currently an intact section of good quality native vegetation.

DBCA has supported the proposition to add this Aqwest reserve to the regional park if an alternative acceptable route is selected.

Due to the constraints associated with impacting sensitive environmental areas compared to other options, this route option has been categorised as “not viable”. DBCA has expressed concern for this route due to the disturbance its installation would cause to the Regional Park and proceeding with the route would likely result in lengthy delays for little to no benefit. This route option was therefore not considered in a high level of detail. The opportunity to offer the Aqwest reserve as an ‘offset’ in support for the final alignment is also recommended.

11. Parade Rd to Bussell Hwy via Centenary Rd

This route begins at the Centenary Rd /Parade Rd roundabout and runs east along Centenary Rd to Bussell Hwy, including a crossing of the highway.

The Centenary Rd road reserve is 40m wide with the two-lane paved road roughly in the middle of the reserve. The verges are therefore quite wide but contain native vegetation. The width of the road reserve indicates that there may be plans for Centenary Rd to be widened to become dual carriageway in future, though this has not been confirmed.

The northern verge contains a high pressure gas main and a Telstra cable, both of which appear to run in proximity of the northern road reserve boundary. On the other side of the northern boundary is a firebreak in the adjoining property. Locating the pipeline in this area would require adequate clearance from the gas main and thus, most likely, a significant amount

of clearing. However, it would most likely locate the pipeline in an area outside of future roadworks if expansion is undertaken.

There is a clear strip in the northern verge of Centenary Rd adjacent to the road pavement. A small number of trees may need to be removed if this alignment is taken, but it is mainly clear with no vegetation or services. The pipeline could potentially be constructed just off the road pavement to minimise impacts to the vegetation. Access to the pipeline in the future could be an issue if the road is widened.

The southern verge contains a large open drain and vegetation that is closer to the road pavement. There appear to be no other existing services on the south side of the road (though there are drains that cross the road from north to south). Therefore, the southern verge appears less suitable for installation of the pipe but may still be a viable option depending on other constraints.

Figure 11: Centenary Rd northern verge, facing west towards Parade Rd

Traffic management will be required if installing the pipeline within the verge of Centenary Rd. It is expected that a single lane closure will be required for installation of the pipe which will impact traffic between Bussell Hwy and Parade Rd.

Trees with potential of providing Black cockatoo breeding and foraging habitat were mapped along both the northern and southern sides of Centenary Rd. Foraging habitat for WRP was also mapped. Any clearing of native vegetation, either in the road verge or within the existing firebreak if required, would require consultation with DAWE under the EPBC Act and would likely be assessed as a Controlled Action. Approval to clear under the EP Act is also required.

At the intersection between Centenary Rd and Bussell Hwy, there is currently ample cleared space for construction vehicles and machinery for trenchless installation under the highway. There are several services and underground structures which run parallel to Bussell Hwy, and

clearances from these will need to be appropriately managed. However, it is anticipated that this will not be excessively difficult due to the depth of the pipeline likely required to cross the highway using trenchless techniques.

A roundabout is proposed to be constructed at this intersection as part of the BORR project, as shown on the plan in Appendix C. The location and level of the proposed roadwork and associated works (such as service relocations) will need to be considered in the detailed design of the Aqwest pipeline. Discussions with the road designer/constructor (South West Gateway Alliance) are underway.

Given the relatively low level of constructability issues and environmental impacts, this route option is given a preliminary rating of "unrestricted".

12. BORR feeder road/BORR between Bussell Hwy and South Western Hwy

An option considered at a high level is following the alignment for the future feeder road to BORR/BORR itself between Bussell Hwy and South Western Hwy. This route would continue from the eastern end of route option 11 and run south-easterly along the proposed BORR feeder road and then north-easterly along BORR itself to South Western Hwy. The full length of this route was not walked on site due to access but was viewed at a desktop level.

This route option runs within currently undeveloped land. It can be expected that construction along the majority of this route will have little to no impact on the community. However due to being undeveloped, access for construction vehicles and machinery could be difficult. According to DBYD data obtained for this area, other utilities will be rarely encountered for the length of the route.

A site survey of the flora and fauna along this route was not conducted, however given that in future the land along this route will need to be cleared for the construction of BORR and its feeder road, it can be assumed that the pipeline can be constructed along this route from an environmental perspective. However this section of the BORR remains under environmental assessment, and the timing proposed for road construction is later than that for this project.

A major issue with this route could be land acquisition, as the pipeline is likely to be constructed prior to the road, and the route runs through the middle of multiple properties. Obtaining approvals for access to the land could result in extensive delays. Approval from Main Roads may also be required.

As the BORR/feeder road is yet to be constructed (or designed in detail), this route also carries a high risk associated with uncertainty. The finished surface levels of the future road are not yet known, and any alignment/level changes to the future road during design can have significant impact to the pipeline, even after installation. This route is also the lengthiest, adding approximately 1,000 m of additional pipeline length compared to the shortest route.

Due to the risks associated with land acquisition and the future BORR design/construction, which could have a significant impact on project timing, this route option has been categorised as "not viable". Given the number of uncertainties around it, the option was not considered in a high level of detail.

13. Centenary Rd between Bussell Hwy and clay pan

As shown in Figure 1, the indicative route originally identified for this project follows Centenary Rd in full between Parade Rd and the BORR project area near South Western Hwy. Route option 13 follows the section of Centenary Rd between Bussell Hwy and through to the western side of the clay pan TEC area (shown on the map in Appendix C). This section of Centenary Rd is unmade road reserve surrounded by undeveloped land. Two sub-options have been developed along this route, which travel through different property types and encounter different conditions. Option 13A runs within the road reserve (along the northern boundary and then

along the southern boundary) while 13B runs just outside the road reserve (to the north and then to the south).

13A. Within Centenary Rd reserve between Bussell Hwy and clay pan

This first sub-option runs solely within the road reserve and is shown as the purple line in Figure 12. From Bussell Hwy, it runs along the northern boundary of the road reserve to avoid the majority of work associated with the future BORR feeder road. In this area, there is an existing gas pipeline running parallel to Centenary Rd in a reserve that is separated from and well to the north of the road reserve. There is therefore an adequate amount of clearance between the pipeline and the gas main (shown as the green line in Figure 12) on this proposed alignment.

Note that a route option within the gas main corridor was not considered in detail in this assessment. Such an alignment is expected to not be viable based on ATCO restrictions and safety issues. Also, the ground is significantly higher in this area compared to the Centenary Rd road reserve and, due to the hydraulics, the pipeline would need to be installed ~3m below surface level along this route. For these reasons, this option was considered at a high level but dismissed early in the route assessment process.

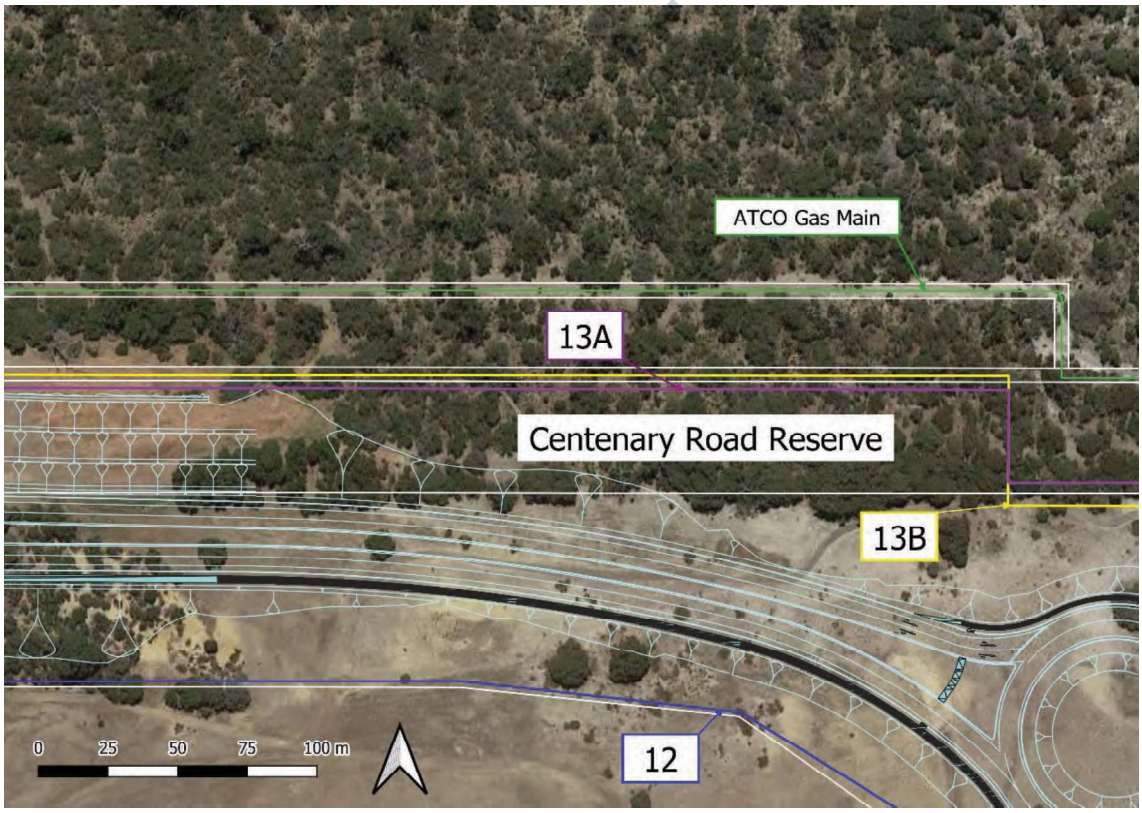

Figure 12: Proposed options along Centenary Rd near Bussell Hwy

The area of the unmade Centenary Rd road reserve closest to Bussell Hwy was historically used as a source of material and spoil storage associated with the highway and possibly other works in the area. The ground is therefore undulating with areas of deep cut and uncompacted fill (potentially including rubbish, rubble, etc.) Locating the pipeline as far north as possible within the road reserve is recommended to help manage the issues and risks associated with the existing ground conditions. Still, additional earthworks are expected to be required for construction access and pipeline installation over and above what would be necessary for a greenfield site. It would be ideal if some of the earthworks associated with the road construction could be completed prior to pipeline installation to minimise the additional work required for the pipeline.

Figure 13: Centenary Rd road reserve near Bussell Hwy, facing west along northern boundary

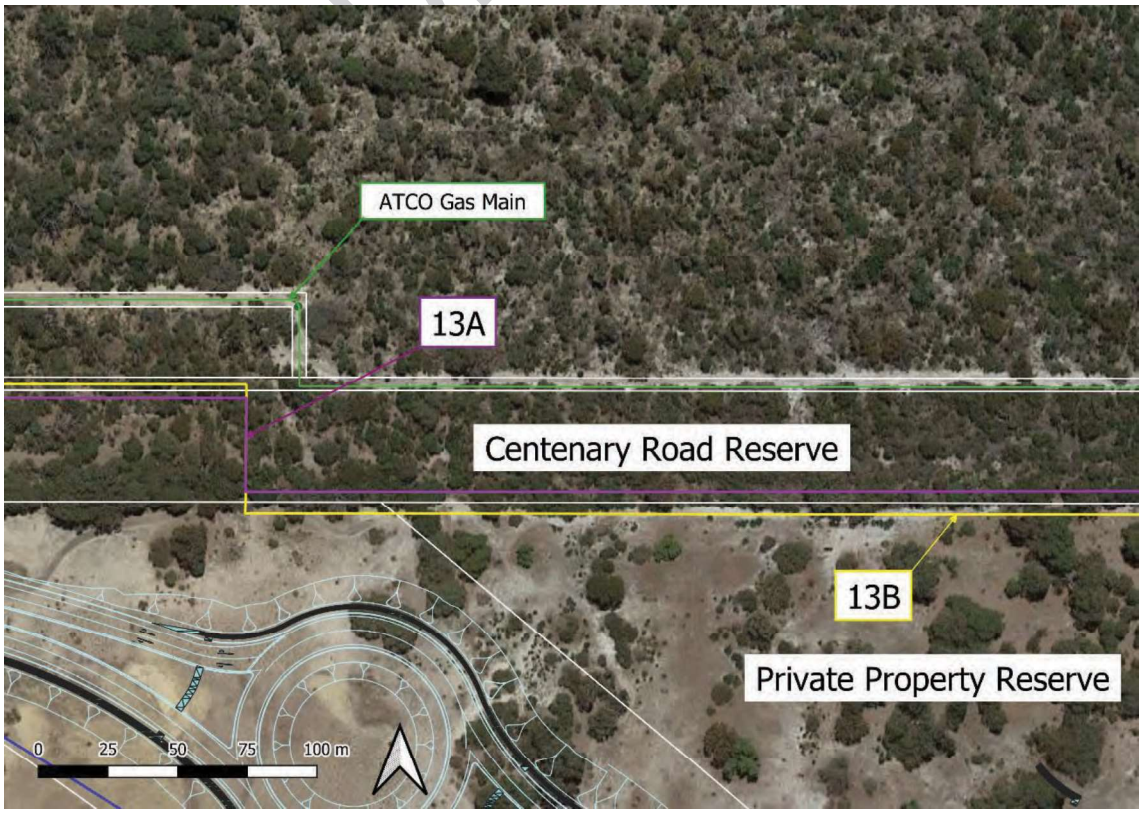

Figure 14: Proposed options along Centenary Rd approaching clay pan

Further east, the BORR roadworks swing south, and the gas main runs in a reserve directly adjacent to (and north of) the Centenary Rd road reserve (as shown on the righthand side of Figure 12 and in Figure 14). The pipeline route option therefore crosses to the south side of the road reserve to maintain adequate distance from the gas main, and the pipeline would remain on this alignment until the clay pan.

While there is some cleared area along the westernmost part of this route, further clearing would be required to allow access for construction vehicles and machinery, and to undertake the large amount of earthworks necessary to level this area/construct the pipeline (and road). Further along this route option, towards where the pipeline transitions from the northern to southern side of the road reserve, the area contains native bushland. Trenchless installation of the pipeline may be considered to help manage environmental impacts. However, installing the pipeline in this manner would result in limited ability to access and maintain the pipeline in future, and would significantly increase the cost of installation. Some clearing would still be required to allow machinery access and laydown.

This route option has been categorised as "negotiable" due to potential access issues for both constructability and future maintenance and based on the environmental impacts.

13B. Within gas corridor and private properties between Bussell Hwy and clay pan

As an alternative to 13A, there may be an opportunity to install the pipeline outside of the Centenary Rd road reserve. There is a narrow reserve adjacent to the road reserve running along the westernmost section which appears to not contain any existing services. It seems likely that this reserve was initially created for the high pressure gas main, but the gas main took an alternative alignment further north, possibly to attain greater distance from the future BORR feeder road construction.

As shown in **Error! Reference source not found.**,Figure 12, locating the pipeline within the existing reserve north of Centenary Road Reserve would provide further clear distance from the proposed BORR construction works than option 13A. It is assumed that this would allow Aqwest operators to access the pipeline more easily in the future as well. It may also require less earthworks, if previous cut and fill activities in this area were limited to the road reserve. However, the pipe reserve appears to be fully vegetated and clearing of a ~10m (minimum, depending on earthworks requirements) corridor would be required. Native vegetation west of the clay pan is predominately fringing vegetation to the northern patch of vegetation and therefore environmental impact is potentially less than if the pipeline was located in the northern reserve section of Centenary Road.

This option crosses to the south side of the road reserve at the same location as Option 13A (as the pipe cannot continue running east within the reserve once the gas main is located within it). However, Option 13B runs outside of the road reserve, in private property outside the southern boundary of the road reserve, where the land has mostly been cleared. There is an existing Telstra cable installed within the properties in this area, so it is already established as a services corridor. While Option 13A may need to be installed via trenchless techniques to minimise clearing, it is likely that the pipe could be installed by open trenching along this route, resulting in cost savings in pipe installation, cost and ability to operate and maintain the main in future. However, this option is subject to the approval of the landowners, which may be difficult and cause delays. The validation of environmental referrals for assessment will require Aqwest to provide evidence of legal access to the land. Delays in gaining this agreement to access the land will delay the environmental assessment process.

Figure 15: Private property south of Centenary Rd road reserve, facing west

Consultation with Geographe Civil indicates that access and construction would be much simpler for Option 13B compared to 13A, with only minor vegetation removal/trimming expected to be required. However, further consultation with private landowners to confirm acceptability of this route is still required. As a result, it is categorised as "negotiable". If early liaison with stakeholders is favourable, this route could be upgraded to "manageable" and be clearly preferred over 13A.

14. Centenary Rd between clay pan and Bunbury Regional Prison

This route begins just west of the clay pan area, crosses the clay pan, and runs along Centenary Rd to the Bunbury Regional Prison (where the paved section of Centenary Rd begins). Like route option 13, two sub-options have been developed for this option.

14A. Within Centenary Rd reserve between clay pan and Bunbury Regional Prison

This option is similar to 13A in that it runs within Centenary Rd along the southern road reserve boundary. The Clay Pan TEC is listed as Critically Endangered under the EPBC Act and Threatened under the EP Act and this route option crosses near the centre of this TEC. Every effort to avoid impacting this TEC is required in order to gain environmental approval. Any residual environmental impact to this TEC would require that Aqwest provide an offset, noting that the purchase of Claypan TEC is difficult due to there being few areas of this TEC remaining and available for purchase on the swan coastal plain. Trenchless installation is the preferred construction method for this environmental value.

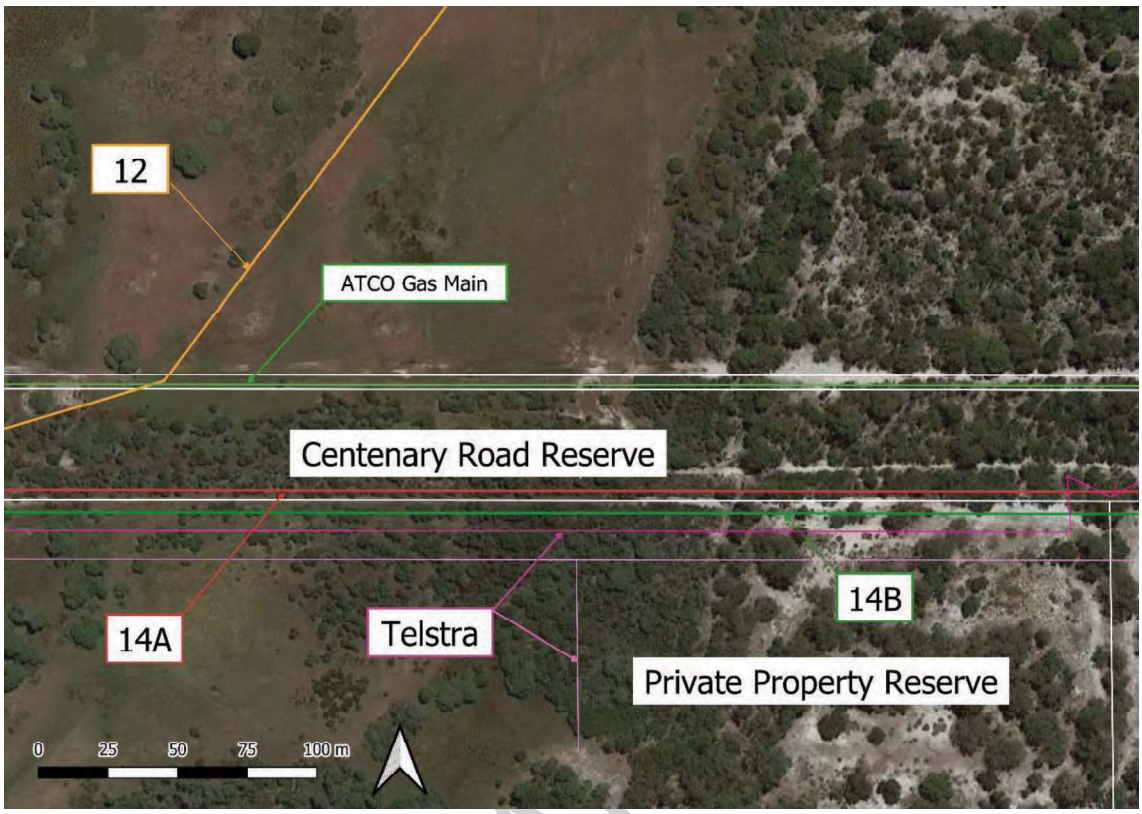

Figure 16: Proposed options along Centenary Rd traversing clay pan

East of the clay pan, there is an existing cleared firebreak/track within the Centenary Rd road reserve, however it is largely overgrown and lies through the centre of the reserve. This would not be an ideal alignment for a pipeline as it could hinder construction of a road within this reserve in the future. The proposed location for the pipeline is therefore along the southern boundary. With this alignment, clearance from the existing high pressure gas main should be easily achieved, as the gas main lies north of the road reserve boundary. Apart from an existing Telstra conduit which travels south of the road reserve boundary, no other services should be encountered.

With the exception of narrow tracks, the majority of the road reserve is vegetated, predominately by the Banksia woodland vegetation community. Foraging habitat also occurs in this section.

Trenchless installation via HDD may be considered for the clay pan crossing and also further east to minimise vegetation clearing. However, as with previous options it should be noted that installation via HDD will result in limited ability to access and maintain the pipeline in the future. Also, it is likely that some vegetation clearing will still be required for access of construction equipment, pipe stringing, etc. Also, HDD introduces environmental risks such as “frac out” of drilling fluid that open trench construction does not. It is also significantly more expensive.

Due to the environmental sensitivity of this area and access difficulties, this route option is categorised as being “negotiable”.

Figure 17: Cleared track within Centenary Rd road reserve facing east - near Bunbury Regional Prison

14B. Within private properties between clay pan and Bunbury Regional Prison

Similar to route option 13B, this option would utilise the private properties which are largely cleared along the boundary to the south of the road reserve. The Telstra cable from Option 13B also runs within the properties in this area, which may make negotiations with landowners easier.

This route option still impacts the sensitive clay pan area described for Option 14A, but is through an area that has a long history of disturbance, particularly with agricultural activity.

HDD installation could still be considered for the clay pan crossing within the private property if deemed necessary from an environmental perspective.

The differences between options 14A and 14B are very similar to those between 13A and 13B. Within the road reserve the land is largely remnant vegetation, however within the private properties the land is largely clear and/or disturbed.

It is anticipated that less HDD would be required for 14B compared to 14A, and that it would therefore likely cost less and be more readily accessible for construction and future maintenance. This alignment however is subject to agreement from multiple private landowners, which could introduce social issues and time delays. For this reason, Option 14B is also labelled as “negotiable”. If early liaison with stakeholders is favourable, this route could be upgraded to “manageable” and be clearly preferred over 14A. Similar to 14A, this option is subject to the approval of the landowner, which may be difficult and cause delays. The validation of environmental referrals for assessment will require Aqwest to provide evidence of legal access to the land. Delays in this gaining agreement to access the land will delay the environmental assessment process.

Figure 18: Private property south of Centenary Rd facing east towards Bunbury Regional Prison

15. Bush track around clay pan

This alternative route to option 14 was presented to Aqwest by DBCA for consideration. This route option runs along bush tracks and the edge of bush blocks, deviating from the Centenary Rd road reserve. It runs through the middle of the clay pan area northeast towards the airport runway then circles back along the property boundary towards Bunbury Regional Prison, tying into the tail of route option 14 at the western end of the paved section of Centenary Rd. The objective of considering this route is to direct the pipeline around the most sensitive parts of the clay pan area to avoid impacting the TEC. This option will require further refinement as it is currently proposed, as advised by DBCA, that the alignment dissects the northern half of the Claypan TEC, this is unlikely to be acceptable. If the DBCA alignment is revised, the alignment is more likely to be required to be located around the entire boundary of the Claypan TEC north of Centenary Road. This alignment will require clearing of native vegetation, including the Banksia Woodland TEC and potential foraging habitat.

DBYD data has not been obtained for this area as it was not previously included within the scope area, however other utilities are not expected to be encountered as the area appears largely undeveloped. A crossing of the existing ATCO gas high pressure main would be required, which is a high risk activity.

The width of the existing track north of the clay pan area is unknown, but from aerial imagery does not appear to be wider than 4 m. It has been suggested that directional drilling could be used to pass the clay pan area, with open cut trenching potentially permissible once following the track. However, given that this area appears to be largely undeveloped, access would be difficult both during construction and after for maintenance unless extensive vegetation clearing is employed. Following this route option would result in a longer length compared to route option

14, adding approximately 400 m to the overall length of the Stage 2 pipeline, increasing capital cost and construction timeframes. Consequently, this route option is categorised as “negotiable”.

16. Centenary Rd between Bunbury Regional Prison and South Western Hwy

Via either route option 14 or 15, the pipeline will arrive at the west side of Bunbury Regional Prison/the western end of the paved section of Centenary Rd, and continue east towards South Western Hwy (and the BORR project area). The proposed end point of the Stage 2 pipeline is indicative but is assumed to be in the northern verge of Centenary Rd at its intersection with South Western Hwy.

Based on site visits and DBYD data, the southern verge appears most suitable for installation due to the presence of many services in the northern verge in comparison. This will also serve to reduce disruption to the prison as the northern verge contains car parks and access ways to the facility. Clearance between pavement and trees in the southern verge appears adequate to install a pipeline and is generally free from other services; however, a lane closure will still likely be required and this will impact local traffic. It is anticipated that conventional open trench installation can be utilised for this portion of the route. If the termination point of the pipeline is in the northwest corner of the South Western Hwy intersection, the pipeline will need to cross Centenary Rd. There are multiple locations where this can be accommodated, and the most suitable location for this crossing can be determined at a later stage.

Figure 19: Centenary Rd at Bunbury Regional Prison, facing east

Accessibility for construction vehicles and machinery for this route option will be high compared with other sections of the route due to the paved road and relatively low traffic volumes. Liaison with Bunbury Regional Prison may be required as a lane closure will likely be necessary for construction, which will impact local traffic. However, aside from a small number of private

properties, Bunbury Regional Prison is the only facility that this road services and as a result disruption to the community will be relatively minor.

Vegetation clearing will be minimal, if required at all. The southern verge is currently used as overflow parking to the prison, and DBYD data suggests that very few services will be encountered. As a result, this route option has been categorised as “unrestricted”.

5.2 Route option comparison

5.2.1 Overall options comparison

The traffic light map in Appendix D illustrates the ratings assigned to each route option as detailed in the sections above. The map allows for readers to make a visual assessment of the combined opportunities and constraints associated with each route option, and the viability of one option compared to another.

Similar to that prepared for the shared Stages 1 and 2 section of pipeline between the WWTP and Parade Rd, a comparison table was developed for the options assessed for Stage 2 between Parade Rd and the BORR. The table outlines the constraints and opportunities associated with each option and uses the colour coding previously adopted to further break down the issues and allow visual analysation and comparison.

Table 4: Route option comparison summary – remainder of Stage 2 (Parade Rd to BORR)

Option		Issues					
		Environmental	Social/Stakeholders	Constructability	Operability	Time	Overall rating
10	Washington Ave and Aqwest Pipeline Reserve through bushland to South Western Hwy	The section from Washington Avenue to Sommerville Drive will avoid impacting native vegetation to a large extent as construction will occur in existing road reserves. The section from Sommerville Drive to Southwest Hwy is not preferred as it will impact high quality banksia woodland and tuart TEC vegetation in addition to fragmenting an existing intact patch of native vegetation	Traffic (particularly Washington Ave) and residences impacted, but impacts may be minimised if traffic movements can be largely maintained	Access through regional park will be difficult as there does not appear to be an existing track along the Aqwest reserve. Levels not examined in detail but could be an issue	Future access to pipeline could be difficult within narrow Aqwest reserve through Regional Park.	Not endorsed by DBCA, and obtaining necessary approvals will likely result in significant, unacceptable delays to the project	**Not Viable**
11	Parade Rd to Bussell Hwy via Centenary Rd	Avoiding impact to the existing native vegetation is necessary as this vegetation maintains the connection between larger patches of native vegetation and the viability of the Preston to Ocean regional park. However, this is expected to be possible	Traffic impacted, but impacts may be minimised if traffic movements can be largely maintained. Road not within a subdivision, and there are detours available if necessary.	Access and topography along this option are preferable. (Alignment should provide adequate clearance from gas main to avoid issues)	Expected ease of access in the future due to existing adjacent paved road	Impacts of required approvals on project timeline expected to be minimal	**Unrestricted**
12	BORR feeder road/BORR between Bussell Hwy and South Western Hwy	DBCA advised their preference for this alignment as the pipeline will be constructed in an area that has received environmental approval and actively avoids impacting the Claypan TEC	Little impact on traffic; however, requires land acquisition from private landowners	Issues with access and topography result in constructability issues along this route	Expected ease of access in the future due to existing adjacent paved road; however, the road is likely to be heavily trafficked, resulting in safety issues to be managed. Also, the pipe may be at the top or bottom of embankments further complicating access.	Could have significant impacts on project timeline, particularly for land acquisition and approval from the BORR alliance (SGA). Is also significantly longer than the majority of options	**Not Viable**
13A	Within Centenary Rd reserve between Bussell Hwy and clay pan	Native vegetation in this section includes Banksia Woodlands and Tuart TEC. The alignment of the pipeline on the edge of the patch mitigates potential environmental impact	Little impact on traffic or other stakeholders	Issues with access and topography result in constructability issues along this route	Future access to pipeline will be difficult as most of the pipeline will be drilled underneath trees.	Impacts of required approvals on project timeline expected to be manageable if clearing is minimised and existing gas corridor is utilised for access	**Negotiable**
13B	Within gas corridor and private properties between Bussell Hwy and clay pan	Native vegetation in this section includes Banksia Woodlands and Tuart TEC. The alignment of the pipeline on the edge of the patch mitigates potential environmental impact	Little impact on traffic; however, requires land acquisition from private landowners (could be upgraded to manageable if negotiations are favourable)	Access and topography along this option are preferable, although there is no existing access track. Installation via open trench is relatively simple along this route	Pipeline would be more readily accessible for future maintenance and operability provided a new access track is created and maintained.	Could have significant impacts on project timeline, particularly for land acquisition (could be upgraded to manageable if negotiations are favourable)	**Negotiable** (could be upgraded to manageable if landowner negotiations are favourable)
14A	Within Centenary Rd Reserve between clay pan and Bunbury Regional Prison	Native vegetation includes Banksia woodland	Little impact on traffic or other stakeholders	Issues with access and topography result in constructability issues along this route	Future access to pipeline will be difficult as most of the pipeline will be drilled underneath trees.	Impacts of required approvals on project timeline expected to be manageable if clearing is minimised and existing gas corridor is utilised for access	**Negotiable**
14B	Within private properties between clay pan and Bunbury Regional Prison	Native vegetation includes Banksia woodland. Survey effort did not identify orchids within the alignment. Vegetation condition in this section is impacted by existing agricultural landuse	Little impact on traffic; however, requires land acquisition from private landowners (could be upgraded to manageable if negotiations are favourable)	Access and topography along this option are preferable, although there is no existing access track. Installation via open trench is relatively simple along this route	Pipeline would be more readily accessible for future maintenance and operability provided a new access track is created and maintained.	Could have significant impacts on project timeline, particularly for land acquisition (could be upgraded to manageable if negotiations are favourable)	**Negotiable** (could be upgraded to manageable if landowner negotiations are favourable)
15	Bush track around clay pan	Banksia woodlands and potential foraging habitat occur on this track. Clearing of native vegetation will be required and effort to show the Claypan TEC is not impacted	Little impact on traffic or other stakeholders	Issues with access and topography result in constructability issues along this route	Future access to pipeline could be difficult unless a new access track is created and is properly maintained, creating additional O&M work for Aqwest.	Impacts of required approvals on project timeline expected to be minimal based on early DBCA advice; however, significant increase to length and thus construction time	**Negotiable**
16	Centenary Rd between Bunbury Regional Prison and South Western Hwy	No environmental impact as the alignment will be entirely within the grassed road reserve	Expected to have little impact on the public or other stakeholders if located within the southern verge	Access and topography along this option are preferable	Expected ease of access in the future due to existing adjacent paved road	Impacts of required approvals on project timeline expected to be minimal	**Unrestricted**

5.2.2 Route option lengths/costs

The indicative lengths and costs for each route option are listed below. Costs have been estimated based on an average rate ([redacted] for the supply and laying of DN375 PVC-M pipe. The costs listed below do not take into account adverse ground conditions such as rock, dewatering, etc. nor do they allow for any HDD sections. The indicative costs are intended for high level comparison based on length only.

Table 5: Route option length and cost summary – remainder of Stage 2 (Parade Rd to BORR)

Route option		Approx. length	Indicative cost
10	Washington Ave and Aqwest Pipeline Reserve through bushland to South Western Hwy	5,180 m	[redacted]
11	Parade Rd to Bussell Hwy via Centenary Rd	730 m	
12	BORR feeder road/BORR between Bussell Hwy and South Western Hwy	4,870 m	
13A	Within Centenary Rd reserve between Bussell Hwy and clay pan	1,310 m	
13B	Within gas corridor and private properties between Bussell Hwy and clay pan	1,320 m	
14A	Within Centenary Rd reserve between clay pan and Bunbury Regional Prison	910 m	
14B	Within private properties between clay pan and Bunbury Regional Prison	920 m	
15	Bush track around clay pan	1,340 m	
16	Centenary Rd between Bunbury Regional Prison and South Western Hwy	1,570 m	

However, comparing the route option lengths individually does not help assess the overall length of each combination. There are a total of four possible routes considered for the Stage 2 pipeline section as summarised in the following table. Note that the sub-options for routes 13 and 14 are not addressed separately in the table, as the lengths and thus the indicative costs are essentially the same.

Table 6: Possible pipeline routes for remainder of Stage 2 (Parade Rd to BORR)

Pipeline route		Total length	Total cost
K	10	5,180 m	$2.8 M
L	11 – 12	5,600 m	$3.0 M
M	11 – 13 – 14 – 16	4,520 m	$2.5 M

Pipeline route		Total length	Total cost
N	11 – 13 – 15 – 16	4,950 m	$2.7 M

As shown in Table 6, the possible pipeline routes are relatively similar in length and cost. However, there is an approximate 20% difference between the shortest route (M) and the longest route (L), with an estimated cost difference of $[redacted]. Refer to the following section for further discussion regarding the route option comparison.

5.2.3 Comparison summary

The main constraints within the project area affecting the pipeline route options include areas of high environmental value, privately owned land/social issues, and future infrastructure developments (namely the future construction of the BORR). Unlike with the section of pipeline shared between Stages 1 and 2, achieving clearances from other utilities is not a major constraint when comparing the different route options, as much of the pipeline traverses through largely undeveloped land for all options considered. However, as shown in the previous section and on the traffic light map in Appendix D, none of the total routes are considered "unrestricted". In fact, two are categorised as "not viable", and the two remaining options contain two sections that are identified as "negotiable" and are therefore categorised as "negotiable".

Given that timing and environmental impacts are critical success factors for this project, routes K and L were dismissed relatively early in the route selection process. DBCA has strong objectives to route option K and is unlikely to get approved. Route L is associated with land acquisition issues as well as potential risks involved with changes in alignment and levels of the BORR, which could impact design and construction of the pipeline. Route L is also significantly longer than many of the other options.

While option 15 (in route N) was suggested by DBCA to minimise disruption to the clay pan TEC and allow for this open cut installation for a portion of the pipeline, it may result in more vegetation clearing due to the apparent narrow width of the cleared track. The route is also significantly longer than option M. The land ownership details are not clear (private property or government-owned reserve) but obtaining approvals to locate the land through the middle of the property could be difficult/timely to obtain.

Based on the above, route M appears to be preferred. The preferred option between the sub-options 13A and 13B and 14A and 14B is less clear. Their main point of difference is the method in which the clay pan TEC is crossed and whether the route lies within the Centenary Rd road reserve or private property. All routes may utilise HDD to some extent to minimise impacts.

While these two options are likely the most favourable routes, both present different challenges to the project. If significant HDD is required to minimise clearing, the road reserve route (13A and 14A) may require more upfront geotechnical investigation work and the resulting pipeline will be more difficult to access due to HDD installation. It is also likely to be significantly more expensive to construct. In contrast, the private property route will be relatively straightforward to construct due to its conventional open cut trenching PVC installation, however may result in significant time delays in order to receive approval to locate the pipe in the existing reserve north of the road reserve (13B) and to acquire the necessary easement within the existing private properties south of the road reserve (14B). If consultation with landowners is favourable, route options 13B and 14B may be upgraded to "manageable" and become the obvious preferred pipeline route. This appears that it would be the best outcome for the project. Further discussion and consultation with stakeholders is required to confirm the preferred pipeline route.

5.3 Recommended pipeline route

As a result of the assessment undertaken, the recommended route for the Stage 2 pipeline is route M (11 – 13 – 14 – 16), with the preferred alignment (A or B; within the road reserve or just outside) subject to further consultation with relevant authorities and landowners. These routes appear the most viable in terms of environmental, constructability, future operability/ maintenance, and project timeline factors compared to the other options. The sub-options present different advantages and challenges to the Stage 2 pipeline, particularly in terms of earthworks, environmental impacts, land acquisition and cost.

This recommendation is based on the information obtained to date. It is recommended that further information gathering and consultation with authorities/stakeholders be undertaken to confirm the viability of this route, and to confirm the preferred alignment, as outlined in Section 5.4 below.

The key obstacles for the pipeline portion of this project are expected to be authority approvals (particularly those required from DBCA), landowner approvals, minimising vegetation clearing and other environmental impacts (possibly by implementing HDD), and delivering water to customers for the new recycled water scheme on time.

5.4 Further recommended action

The recommended actions to confirm the preferred pipeline route option/sub-option and its viability and to progress the pipeline design include:

- Continue liaison with DBCA and other authorities in regard to the proposed clearing and managing environmental impacts, including the acceptability of proposed HDD drill shots (and sections where this installation method would be required) within Centenary Rd (including the clay pan crossing);
- Consult with the proposed affected landowners to determine their level of acceptance regarding construction of the proposed pipeline in their properties, alongside the existing Telstra cable;
- Liaise with the owner of the empty pipeline reserve to the north of Centenary Rd near Bussell Hwy to determine the feasibility of locating the Aqwest pipeline on the property;
- Undertake service locating in key locations (particularly along Centenary Road between Parade Rd and Bussell Hwy as well as near Bunbury Regional prison) to determine a viable alignment for the new pipeline;
- Liaise with the City of Bunbury regarding construction along shire roads and issues such as reinstatement requirements and limiting impacts to residents, particularly near Bunbury Regional Prison;
- Instigate other site investigation work such as topographical and feature surveys, geotechnical investigations, etc. along the proposed route;
- Once survey and services data are obtained and the results of preliminary stakeholder discussions are available, set the pipeline alignment and identify the proposed construction corridor (to allow environmental applications to be submitted in a timely manner); and
- Request to authorities that any future proposals by others along the proposed route be made known to Aqwest for discussion prior to implementation. This is particularly applicable to where the pipe runs in road reserves, where land rights cannot be obtained/the route cannot otherwise be secured prior to construction;

- Obtain legal access to the land, where required, once the preferred alignment is determined.

6. Route assessment – Parade Rd to Forrest Park (remainder of Stage 1)

6.1 Route option details and ratings

As discussed in Section 3, several route options were identified and assessed for the section of pipeline between the Stage 1/Stage 2 bifurcation and Forrest Park, for the Stage 1 pipeline. The options were divided into several segments, which are numbered on the map in Appendix E and correspond to the numbering of the below sections describing the associated conditions and issues.

Note that the intention for pipe installation for Stage 1 is to avoid clearing of native vegetation. The avoidance of clearing will avoid the associated approvals and is expected to allow Stage 1 to continue relatively unhindered in this respect. Given that native trees in this area are reasonably few, this is expected to be achievable. Particular pinch points will require further discussion during the next design phase to determine the pipeline alignment in regard to existing trees, services and other features.

17. Parade Rd to Washington Ave

The starting point for the Stage 1 pipeline is at the proposed bifurcation point on Parade Rd, and runs north along Parade Rd until reaching Washington Ave. This is the only option considered in detail up to Washington Ave.

South of Payton Wy, the eastern verge along Parade Rd appears to be suitable for laying the pipe. The western verge is quite narrow, and there are existing ATCO gas pipelines and Western Power underground lines. There is also a dual use path and solar lighting, with vegetation in close proximity. The eastern verge is significantly wider in this area and there appears to be ample clearance between the pavement and property boundary to lay the pipeline. Telstra appears to be the only existing service in this area.

Just north of Payton Wy, Parade Rd widens and becomes dual lane, and the eastern verge becomes narrower in size. Preliminary DBYD data indicates that services are more congested north of Floyd Crescent, however the verge appears to remain of sufficient width for the proposed pipeline. Of particular importance is the presence of a large diameter sewer pressure main which is also located in the eastern verge. Potholing will be required to ensure adequate clear distance from this main is achieved, as this pressure main services the Bunbury WWTP. In the northern portion of this route more drainage structures and several lighting structures are present and will need to be avoided. This persists up to the corner of Washington Ave and Parade Rd, where there are multiple electrical conduits, appropriate clear distances will need to be managed.

Some vegetation clearing would be required along this route if the pipeline is located in the verge. However, it is anticipated that clearing of native vegetation will be avoided by deviating into the road pavement if necessary.

As this route travels along paved road, access for construction vehicles will not be an issue. This route is also preferable from an operability and maintenance perspective as the pipeline will be relatively simple to access. Provided that adequate clear distance from the pavement and other services can be achieved, safety risks to Aqwest operators can be minimised by installing the pipeline further into the verge. The installation of the pipeline along this route may require a lane closure and associated traffic management subject to a confirmed alignment.

Given the relatively standard constraints of achieving appropriate clear distances between services and a relatively large verge for this portion of the road, this route option has been

categorised as “manageable”. Some vegetation trimming may be required in isolated locations; however this is not expected to impact the construction of this route option significantly.

Figure 20: Parade Rd, facing south towards Centenary Rd roundabout

Figure 21: Parade Rd near Cranbrook Wy, facing north

18. Washington Ave to Hay Park via Parade Rd

This route crosses Washington Ave on the eastern side of the Parade Rd intersection, continuing on the same side of Parade Rd as route 17. It is anticipated that trenchless techniques may be required for the crossing of Washington Ave, as this is a major link to/from Bussell Hwy and the western residential areas.

From the corner of Parade Rd and Washington Ave, this route option travels further north via Parade Rd for the full length of Hay Park. Along the way it is anticipated that there will be a number of day tank locations (number to be confirmed), and offtakes to feed these tanks will cross into the Hay Park complex.

Continuation of the pipeline in the eastern verge appears to be the most suitable option, as the western verge is significantly narrower and contains gas as well as western power overhead lines. It is noted that there are two large diameter (DN450) sewer pressure mains in the eastern verge along with an Aqwest water main and telecommunication cables. Adequate clearance, particularly away from the sewer mains, will need to be managed, and accurate service locating via potholing will be required for detailed design.

Like with route option 17, there appears to be little vegetation along this route in the verge, though some clearing and/or trimming may be required to install the pipeline along this route. Every effort however will be made to avoid clearing native vegetation along this route.

There are several car parks and access roads that this pipeline route would cross, and installation would therefore impact visitors of the park. Additionally, along this route there is also a Water Corporation sewer pump station which would be passed. Liaison with Water Corporation will be required so that access to this sewer pump station is maintained throughout construction.

Figure 22: Parade Rd facing north, adjacent Hay Park Community Hall

Like with route option 17, this route travels along paved road and therefore access for construction vehicles and machinery will not be difficult. This route appears preferable from an operability and maintenance perspective, provided that adequate clear distance from the sewer pressure main and the road pavement can be achieved. It is possible that a lane closure along Parade Rd would be required to install the main within this verge.

Due to unknowns surrounding the location of the two sewer pressure mains and likely disruption to the community due to lane closures/traffic impacts on such a major thoroughfare in the area, this route option has been categorised as "manageable". While not ideal, these issues are expected to be able to be managed during design/construction.

19. Hay Park Detour

As an alternative to route option 18, the option of installing the pipeline within Hay Park was explored. This route option begins from route option 17 and travels east for a short length within the southern verge of Washington Ave. It then crosses Washington Ave and utilises the existing access pathway for the City of Bunbury open drain travelling north through Hay Park. As with route option 18, it is anticipated that HDD will be required to cross Washington Ave.

There are several services running west to east on both verges of Washington Ave which will need to be avoided/crossed. However, once the pipeline is within Hay Park there appears to be no other services to be encountered for a great length, other than park reticulation and minor services to buildings. Furthermore, using this route would allow the existing drainage track to be used for future pipeline access and reduce the need for vegetation clearing.

Eventually the access path adjacent the drain ends, and the pipeline will need to be installed in car parks or take inner road detours to avoid underground structures such as building footings and light pole footings, and to deviate around playing fields.

Figure 23: ATCO Gas main crossing over drainage channel within Hay Park, image facing south

Figure 24: Facing south within Hay Park

Access for construction vehicles to install the pipeline along this route should be manageable provided that sections of the park may be closed for construction. The City of Bunbury has indicated a preference for this route over the Parade Rd option based on its reduced social impacts.

It is anticipated that the existing cleared areas can be used to install the pipeline for a large portion of the main and every effort will be made to avoid clearing native vegetation.

Access for construction and future operability and maintenance is expected to be manageable along this route through the park. Portions of the car parks may need to be closed off from the public during construction, however Parade Rd should remain largely unaffected.

Due to the City of Bunbury's preferences, reduced impact on traffic and minimal difficulty with achieving clearance from other utilities compared to route option 18, this pipe route option has been categorised as "unrestricted". Note that the route shown on the maps is indicative only, and the preferred alignment through the park should be determined in the next design phase in consultation with the wider design team and the City of Bunbury to take into account the tank locations and to minimise social and environmental impacts.

20. Washington Ave to Hay Park via Bussell Hwy

As a third alternative, the pipeline may be installed along Bussell Hwy as opposed to Parade Rd, on the eastern side of Hay Park. This route option was not looked at in detail but was viewed at a desktop level.

Part of this route option was assessed in route option 9, where from the Bunbury WWTP the pipeline would travel along Washington Ave further east towards the BORR construction site. Once reaching Bussell Hwy, this pipeline would then travel north towards Hay Park. Clearances from other services would not be difficult to achieve along Washington Ave, as most services along this road are located within the northern verge. However, the western verge of Bussell Hwy contains many existing services running parallel including overhead power lines, Aqwest water mains and ATCO pressure gas mains. The initial portion of the route along Bussell Hwy may have sufficient verge space to install the pipeline while maintaining appropriate clear distances, however the verge becomes narrower as it approaches Hay Park. Installing the pipeline within the eastern verge appears possible, however this would involve additional road crossings, and another ATCO gas main is located in this verge as well. Further north there may be difficulties achieving clear distances between the pipeline and road pavement and other utilities without some vegetation clearing. Installing the pipeline along the eastern side of Hay Park does not appear viable due to the dense native vegetation in the southern half of the park in this area. The preferred route for this pipeline is to directly avoid native vegetation negating the requirement for a Clearing Permit.

The main issue with this route option is that MRWA does generally not allow services within its road reserves, as the services can constrain opportunities for future roadworks, widening and maintenance. Consultations and the approvals process with MRWA regarding this route could be lengthy and may not result in agreement.

Construction access for this pipeline route would not be an issue, as paved road accompanies the pipeline route for its length. However, it is likely that construction along Bussell Hwy would require a lane closure and traffic management, and approvals from Main Roads to conduct this could result in lengthy delays. Future access to operate and maintain the water main would likely be achievable, however may be a high-risk activity (due to vehicles travelling at high speeds along the highway) dependent on where within the verge the pipeline is installed.

Due to high uncertainty with the location of services and likely schedule delays, this route option has been categorised as "negotiable". While it is possible that construction along this route

could be achievable with clear distances from other services, it is unlikely that the pipeline can be constructed within an appropriate timeframe.

21. Hay Park to Bunbury Turf Club via Parade Rd (Minor)

At the northern end of Hay Park, the main, dual-carriageway section of Parade Rd turns east and connects to Bussell Hwy. A minor road that is also named Parade Rd runs directly north, instead of turning east, and eventually becomes Adam Rd. Route option 21 follows the minor Parade Rd north into residential area. This route runs along the residential street before entering a shopping complex car park (shown on mapping as Vasse St), before reaching Bussell Hwy.

Through the residential area, there are several other utilities (including overhead power) residing within the western verge of Parade Rd and few in the eastern verge. The verges appear narrow, however with few services it may be possible to achieve clear distances from other utilities installing the pipeline along the eastern verge. There appear to be some small trees within the eastern verge, and these may need to be removed if installing the pipeline along this route. Deviating into the road pavement may therefore be required. It should be noted that before reaching the car park further north, the pipeline will need to cross under western power overhead lines.

Clearance from other services becomes more difficult near the shopping complex car park. There is a large green open space between Bussell Hwy and the car park, however this area contains other utility services and trees. It may be possible to avoid the existing services and minimise clearing, as the trees are generally well spaced. It is anticipated that installing the pipeline within the car park/Vasse St would cause significant disruption to local businesses and the community.

There are isolated patches or single trees established in this section of the route and these can be avoided. Fauna studies confirmed this vegetation does not support threatened or priority species.

Access for construction should be manageable, as a lane closure along Parade Rd within the residential area should have relatively low impact on the community. Approaching the car park towards Bussell Hwy, the large green space between Bussell Hwy and the car park can be used, however it is possible that overflow of the construction corridor into the car park may be required to minimise clearing and impacts on existing services. This impact would be less than installing the pipeline within the car park, however it may still be unfavourable to the City of Bunbury and the local businesses.

This area is quite congested and impacts to local traffic/residences/businesses would be relatively high compared to other sections. However, as the pipeline in this area will be quite small and the issues are regularly encountered and managed on similar pipeline projects, the route is categorised as “manageable”.

22. Hay Park to Bunbury Turf Club via Bussell Hwy

As an alternative to option 21, this option follows Bussell Hwy from the northern end of Hay Park to the Bunbury Turf Club. At the main roundabout, this option will require HDD crossings of both Bussell Hwy and Brittain Rd. Once these crossings are achieved, it is assumed that the pipeline will be able to run within the western outskirts of the Bunbury Turf Club property, as the highway verge is quite narrow and contains existing services. Note that Bunbury Turf Club intends to obtain land from MRWA at the Parade Rd/Bussell Hwy intersection as shown in the figure below (provided by Geographe Civil). It is understood that the existing water main will soon be relocated to within the new boundary of the highway.

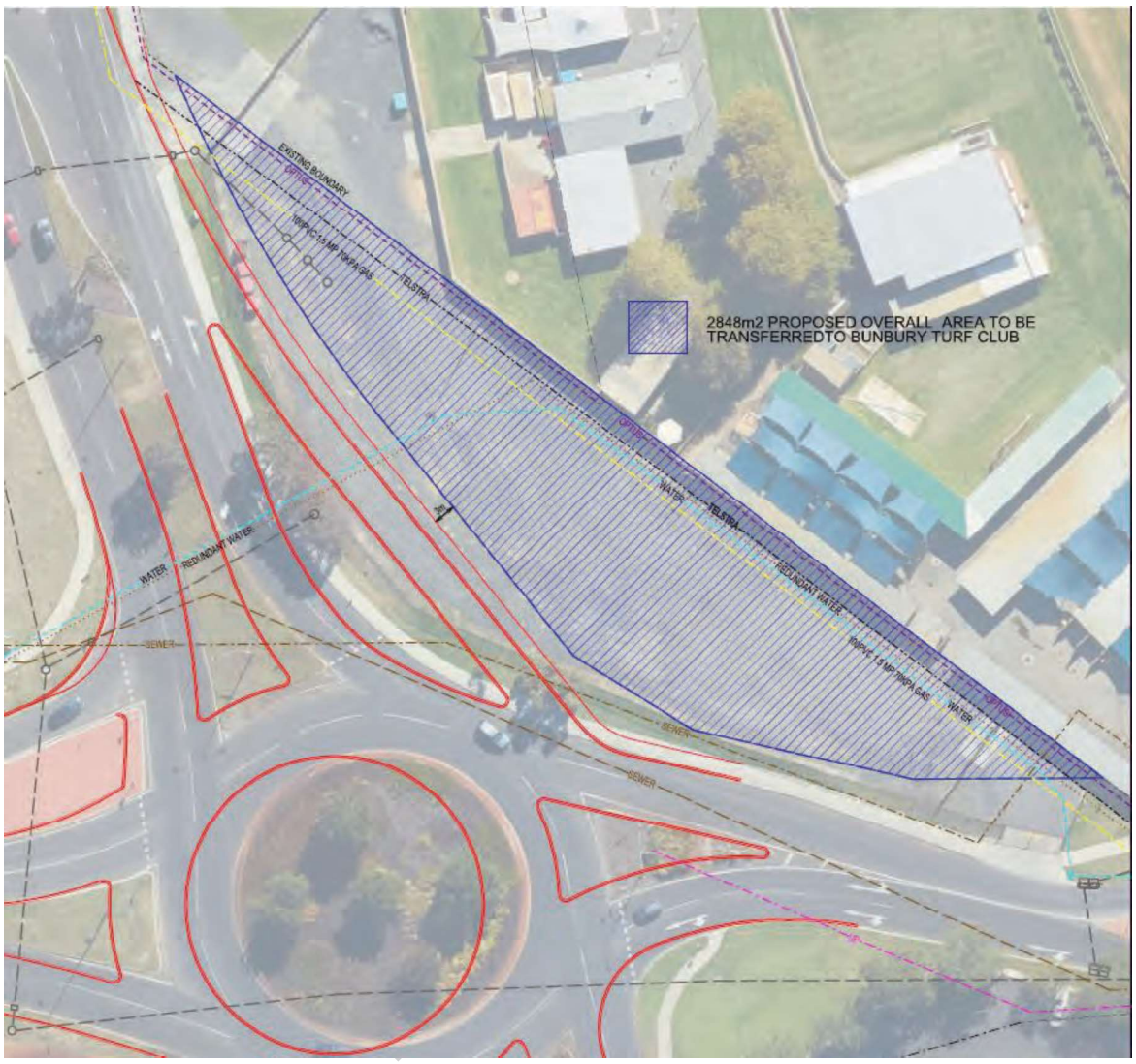

Figure 25: Proposed land resumption by Bunbury Turf Club at Bussell Hwy/Parade Rd/Brittain Rd

Given that the turf club is a potential future customer of the WRRS, it is anticipated that they will be amenable to allowing the pipeline in their land. However, this is a major assumption that largely impacts the viability of this route option.

Within the turf club property, few services are encountered, and there is ample space between the road pavement and turf club facilities to locate the pipe within. There is also an existing footpath with reasonable clear distance from the pavement which appears to only contain telecommunication cables within its vicinity. Locating the pipeline here would allow adequate clearance from other services while achieving ease of access for construction and future operation and maintenance.

Vegetation clearing along this route will be minimised as much as possible, though some local clearing and/or pruning may be required. No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.

Figure 26: Bussell Hwy adjacent Bunbury Turf Club, facing north

Construction access for this route option would be preferable for most of this pipeline route. There is ample space for construction vehicles and machinery adjacent Bunbury Turf Club, however the access for trenchless sections at the roundabout between Bussell Hwy and Brittain Rd will be relatively tight. It is possible however to have the HDD sections be launched from Hay Park and the Turf Club parking lot, so the installed pipes surface at the tighter verge between Brittain Rd and Bussell Hwy, minimising the required construction footprint at this location. It is possible that after the two road crossings, construction may be conducted without the need to close a lane on Bussell Hwy.

Along Bunbury Turf Club the existing pathway appears to be a suitable alignment to follow, remaining within already cleared space. This will also result in ease of access for future operation and maintenance of the pipeline, as it will be in readily accessible land.

This pipeline route has been categorised as “manageable”, as most of the issues are associated with constructability and are seen to be manageable. However, working in the vicinity of this busy roundabout is not ideal. And early liaison with the Bunbury Turf Club regarding locating the pipeline in their land is critical to this option. Without approval to locate the pipeline in turf club property, the route is likely to be considered “not viable”.

23. Bunbury Turf Club to Nuytsia Ave via Bussell Hwy

North of options 21 and 22, the pipeline would continue to travel north along Bussell Hwy within the turf club property. While there are several existing utilities that run parallel along the verge including Western Power lines directly adjacent the road pavement, there is a large clearance between the road verge and the turf club facilities that can accommodate the pipeline. There is an existing foot path that runs between the park and the road which appears to only contain a Telstra service in the vicinity and locating the pipeline along this footpath would appear to give adequate clearance to other services.

Vegetation clearing along this route will be minimised as much as possible, though some local clearing and/or pruning may be required. No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.

Construction and operations/maintenance access to this area is expected to be reasonably good, if the turf club allows the pipe in its land.

Given the lack of issues expected, this option has been categorised as "unrestricted"; however, this rating is entirely dependent on Bunbury Turf Club allowing the pipeline within its property. Without this approval, the route is likely to be considered "not viable".

24. Hay Park to Nuytsia Ave via Brittain Rd

As an alternative to routes 21, 22 and 23, the option to lay the pipe further eastwards around Bunbury Turf Club has been proposed. This option was added later in the route assessment stage and thus was not walked on site and was viewed at a desktop level only.

Following from either route options 18, 19 or 20, this route involves a series of HDD installations like route option 22 in order to cross Bussell Hwy and Brittain Rd to reach the Bunbury Turf Club. Trees line the northern verge of Brittain Rd, so installation along this route would need to be just within the grounds of Bunbury Turf Club to avoid clearing. Confirmation is still required if these trees constitute native vegetation as they may be planted ornamentals. No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.

Along this eastern and northern alignment within the turf club is a DN375 GRP sewer main, and a similar alignment to this pipeline with appropriate clear distance should be achievable. To reach Nuytsia Ave, the pipeline would need to cross a City of Bunbury owned open drain channel, where HDD installation could be used.

Figure 27: Brittain Rd/Bunbury Turf Club

Construction access and future maintenance access should be achievable as the pipeline would be installed in green open space for most of this route option. Aside from the two trenchless crossings at Bussell Hwy and Brittain Rd, no other services will be crossed for the length of this route option.

A pipeline route option heading west along Nuytsia Ave to connect this route option back to the end of 23 was reviewed at a high level. The northern verge of Nuytsia Ave is full of services which will likely not allow the installation of a new main, and the southern verge contains western power overhead lines. The grounds within Bunbury Turf Club south of these overhead

power lines are dense with trees, and so it has been inferred that a pipeline along Nuytsia Ave in the east-west direction is not viable.

Due to relative ease of access and reduced construction constraints, this route option has been categorised as “manageable”. Like route option 22, the viability of this route is contingent on acceptance from Bunbury Turf Club for the installation of the pipeline within their grounds. Should this proposition not be accepted, this rating may change to “not viable”. It should be noted that using route option 24 compared to the alternatives adds an additional 500 m to the overall Stage 1 pipeline.

25. Nuytsia Ave to Hands Oval via Blair St

Following on from route 23, this route option continues north along Blair St until reaching the Clarke St intersection where Hands Oval is located.

North of Nuytsia Ave, the Blair St verges are very narrow and contain several services on both sides. Overhead power lines, water mains, sewer mains and telecommunication cables all exist on the eastern verge while the western verge contains telecommunication cables and gas and sewer mains. There are also several trees on the western verge limiting available space even further. Given the width of the verge available, it is unlikely that clear distances to other services can be achieved installing the pipe within either verge.

The island through the middle of Blair St separating north and south bound carriageways contains several trees and light structures. Therefore, this is also not a viable location to install the pipe.

There are a relatively large number of trees in the verges of this road, which likely have high value to the community. These trees, even if planted are likely to constitute native vegetation and if the removal of these trees is required, a permit to clear is required. Every effort is being made to avoid clearing native vegetation. No known threatened or priority species occur within this vegetation.

Along much of the route, there are also existing sewer mains under the road pavement in the eastern carriageway. Near Frankel St, the sewer infrastructure appears to drift into the western carriageway. The most appropriate location for the pipeline along this route appears to be under the pavement in the western carriageway of Blair St, though this is obviously not ideal.

As a result of the narrow verges and several utilities located within both sides of Blair St, this route option has been described as “negotiable”. Further investigation into the existing services and other constraints could lead this route to ultimately be “not viable”.

Figure 28: Blair St facing north towards Hands Oval

Figure 29: Blair St facing north adjacent Hands Oval

Figure 30: Blair St facing south, south of Hands Oval

26. Nuytsia Ave to Hands Oval via Spencer St

As an alternative to route option 25, a route utilising residential roads west of Bussell Hwy to reach Hands Oval has been considered. This route option deviates west off Bussell Hwy/Blair St towards Spencer St, then follows Spencer St north until reaching Hands Oval.

The crossing of Bussell Hwy can be achieved at a cul de sac on Spencer St. There appear to be few services in this location and clearances should be easily achieved. The western verge travelling north from this point contains Western Power overhead power lines, ATCO gas and Aqwest water mains while the eastern verge is lined with trees. However, there may be sufficient clearance between trees and the road pavement, as only telecommunication cables exist in the eastern verge. There also appears to be a sewer main along this route, and DBYD data shows this to be under the road pavement. The services within each verge appear to change as the route progresses north, so accurate potholing will be required to verify the services that lie within the eastern verge and alignment to achieve clearance to these services.

Figure 31: Screenshot from GIS model showing DBYD data of Spencer St near Bussell Hwy/Blair St

Contingent on pothole service locating, it may be possible to install the pipeline within the verge without the need for vegetation clearing along much of the route. However, there are several locations where there are trees within the eastern verge which may pose difficulty when installing this pipe. Removal of any verge vegetation is unlikely to be favourable to local residences and may require a permit to clear native vegetation unless the vegetation comprises ornamental species. Early contractor advice has suggested however that short bore sections under obstacles such as trees and other minor structures may be possible. Alternatively, the pipeline may need to deviate into the road to avoid trees.

While it is largely residential within the suburb of South Bunbury, Spencer St connects to central Bunbury further north. It is a relatively busy north-south road in the area and construction along this route is likely to impact not only local traffic but wider road users.

Once the pipeline reaches Hands Oval, the route turns east onto Halsey St back towards Bussell Hwy. There are again Western Power overhead lines in the northern verge, as well as telecommunication cables, however the verge is wide, and clearance can be easily achieved by diverting the pipeline further into the park. Vegetation clearing should be avoidable in this area.

The same principle as above also applies as the pipeline travels north along Bussell Hwy, where clearances from services (including a gas main) in the western verge of Bussell Hwy could be achieved by installing the pipe within the park, around the perimeter of the oval. This route would also avoid trees and consequent vegetation clearing. A final HDD road crossing at Bussell Hwy would be required near Gorman Loop to reach the eastern side of the highway to supply Forrest Park.

Access for construction should not be difficult along this route, as it utilises residential paved roads and the park for the entirety of its length. Similarly, access for future operation and maintenance along this route is favourable as the pipeline will be installed within easily accessible areas. However, as a result of installing within residential verges, customer driveways will be affected during construction and future repair works. And the high congestion in this area means access will not be unrestricted.

Due to the constrains associated with existing services and impacts on traffic (both local and through traffic) and residences, this is categorised as “negotiable”. Further investigation of the constraints such as existing services and trees would be required before a viable alignment can be confirmed.

27. Nuytsia Ave to Gorman Loop via Little St

As an alternative to both route options 25 and 26, a pipeline through the residential area east of Blair St (following from route option 24) has been investigated. Due to its late inclusion (based on the “negotiable” status of options 25 and 26), this route was not walked on site but was viewed at a desktop level.

This route option begins on Nuytsia Ave and travels north westerly along Little St, before following Mitchell Crescent using green open spaces along the way. It has been assumed that the City of Bunbury would be amenable to the use of these small green open spaces, as these routes minimise impacts to residents along the route as much as possible compared to being located in road reserves/verges.

At the Mitchell Cr/Wilson St intersection, the pipeline route veers off Mitchell Cr through public open space between Midgley Cl and Minors Fawy, crosses Jury Bend, and then runs along Biesiot St to Gorman Loop/Lawhill Ent.

There are several sections along this route option where the pipeline will likely need to be installed within the road, perhaps just under the kerb, as both verges are congested with buried services, overhead power lines and/or trees. This occurs along Little St, Mitchell Cr and Biesiot St. Several large trees along this route are likely to contain significant community value and clearing these would likely not be preferred. While no known threatened or priority species occur along this section of the route, every effort is being made to avoid clearing native vegetation.

Figure 32: Screenshot from GIS model showing DBYD data of Little St

Constructing under the road will impact cost as well as traffic movements. However, these roads appear to contain mainly local traffic only, as opposed to the Blair St and Spencer St options, which would impact more through traffic.

An alignment using Gibbs St, northeast of Little St, was also considered as an alternative, since this street appears to contain fewer trees. However, achieving clearances to services along Gibb St would still result in the pipeline being installed within the road, and further complexities in clearances from services would occur at Frankel St, so the Gibb St option was not considered further.

Access for construction should not be an issue as the route follows paved road, however future maintenance of the pipeline installed within roads will be difficult. Installation within green spaces previously mentioned would reduce amenity to the public playgrounds, both during construction and for future maintenance, though these events are expected to occur infrequently and for short periods of time.

At the tail end of this route option, an offtake would be required (following approximately route option 29 in a westerly direction) to service the day tank at Hands Oval. As a result, a road crossing under Blair St would still be required if using this route option, and additional pipe length would be required for this offtake compared to other options (which run within Hands Oval itself, minimising the offtake length).

Due to the constrains associated with existing services and impacts on traffic (though this is expected to be mainly local traffic only) and residences, this is categorised as “negotiable”. Further investigation of the constraints such as existing services and trees would be required before a viable alignment can be confirmed.

28. Hands Oval to Forrest Park via Blair St

Either from route option 25 or 26, the pipeline will need to reach the final supply location of Forrest Park. This route option continues north from Gorman Loop along Blair St to reach Forrest Park.

DBYD data indicates that water, sewer, and gas lines run along the eastern verge of Blair St, while Western Power overhead lines run along the western verge. The verge is also very narrow, with minimal distance between the pavement and the boundary wall. The verge also contains vegetation which would need to be removed along with the walkway, and a lane closure along Blair St would certainly be required to install the pipeline in this area. No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.

However, given this verge is so narrow it is unlikely that the pipeline can be installed within the verge while achieving clear distances from other utilities. There is also an existing wastewater pressure main under the easternmost lane of Blair St.

Figure 33: Blair St from Forrest Park facing south

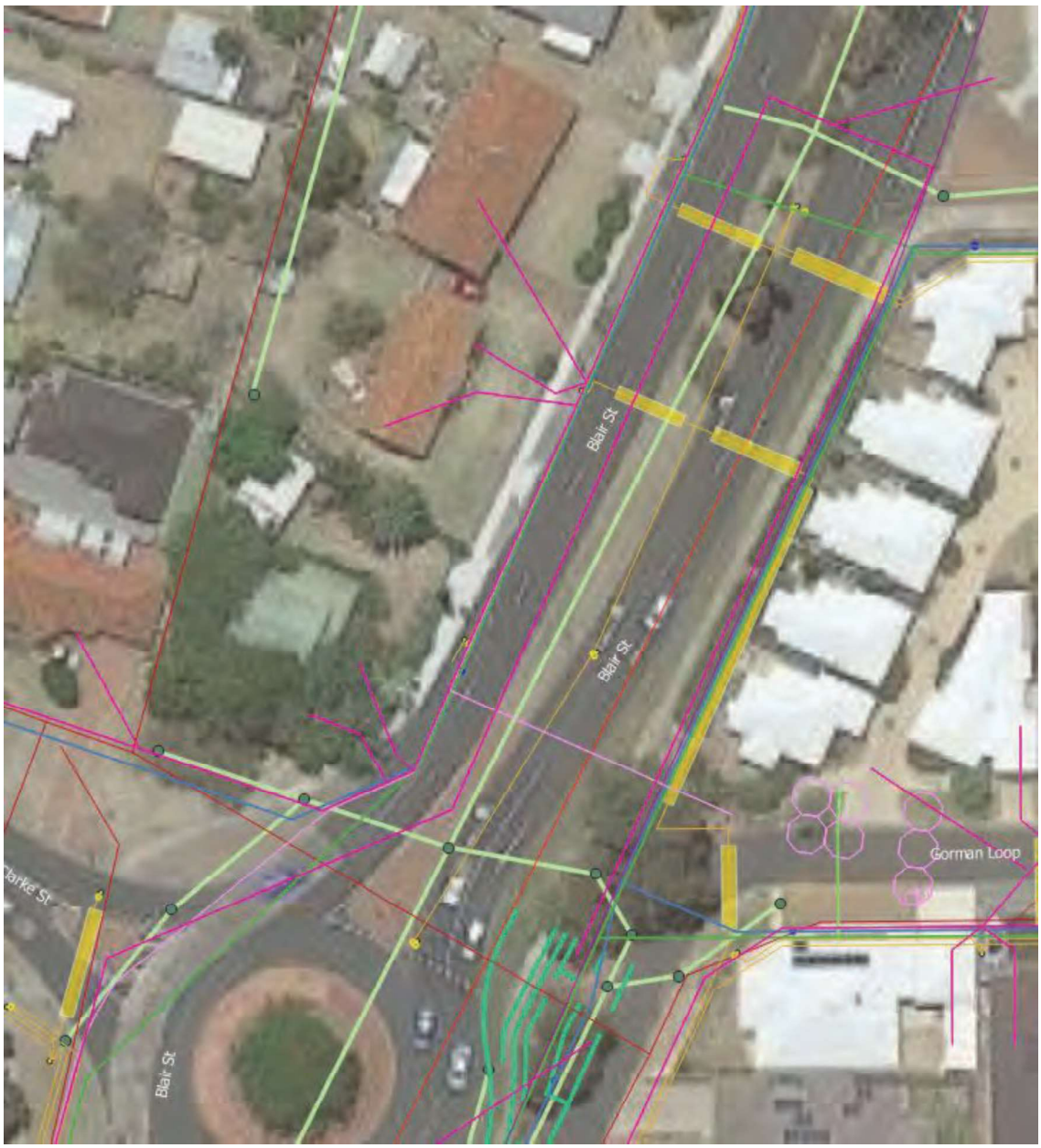

Figure 34: Screenshot from GIS model showing DBYD data for Blair St between Gorman Loop and Forrest Park

As a result of the issues with construction and future access in addition to clearance from services, this route option has been categorised as “negotiable” but bordering on “not viable” despite its short length. The only viable option may be to install the entire length (approximately 125 m) between the Clarke St/Gorman Loop and Forrest Park via HDD under the eastern verge.

29. Gorman Loop Detour

An alternative route travelling within the nearby residential area to the east of Blair St was also explored. This route option begins at the junction between Hardwick Bend and Gorman Loop and continues east along Gorman Loop.

This route utilises the lower trafficked residential road for installation of the new pipeline (compared to Blair St). According to DBYD information, all services running along Gorman Loop run along the southern verge, apart from power domes which exist on the northern verge. Therefore, it is possible that the pipeline could be installed within the northern verge, or in the road.

Vegetation clearing does not appear to be required along this route. Access for construction would also be preferrable along this route, as the road is paved, and disruption to the community would be minimised to local residents only. Future operability and maintenance of the main would also be manageable as a result.

Figure 35: Screenshot from GIS model showing DBYD data for Gorman Loop

In combination with route 30, this route option is likely to cause less traffic/community disruption and is superior from an operability and maintenance perspective compared to route option 28. The issues associated with this route are encountered on many similar pipeline projects. As a result, this route option is categorised as "manageable".

30. Gorman Loop to Forrest Park via Biesiot St

Following from either route option 27 or 29, the final leg to Forrest Park begins at the junction between Gorman Loop and Biesiot St. This route option travels north along Biesiot St to reach Forrest Park.

Like route option 29, this route uses a lower trafficked residential road for installation of the new pipeline instead of the high traffic Blair St. According to DBYD information, services run along the western verge, and the eastern verge is relatively free of services apart from power domes and local drainage (which does appear to include some large pits). There are also light posts along Biesiot St, and the alignment would need to consider deviating from these structures to avoid undermining the footings. There is a footpath in the eastern verge, which would require restoration if the pipeline was constructed in this area. Alternatively, the pipe could be constructed under the road.

Figure 36: Screenshot from GIS model showing DBYD data for Biesiot St north of Gorman Loop

As with route option 29, vegetation clearing does not appear to be required along this route. Similarly, construction and future operability access is preferable along this route, and disruption to the community would be minimised to local residents only.

In combination with route 29, this route option is likely to cause less traffic/community disruption and is superior from an operability and maintenance perspective compared to route option 28. The issues associated with this route are encountered on a large number of similar pipeline projects. As a result, this route option is categorised as “manageable”.

6.2 Route option comparison

6.2.1 Overall options comparison

The traffic light map in Appendix F illustrates the ratings assigned to each route option as detailed in the sections above. The map allows for readers to make a visual assessment of the combined opportunities and constraints associated with each route option, and the viability of one option compared to another.

Like those prepared for the other sections, a multi criteria comparison table was developed for the route options assessed for Stage 1. The table outlines the constraints and opportunities associated with each option and uses the colour coding previously adopted to further break down the issues and allow visual analysation and comparison.

Table 7: Route option comparison summary – Stage 1 (Parade Rd to Forrest Park)

Option		Issues					
		Environmental	Social/Stakeholders	Constructabilitly	Operability	Time	Overall rating
17	Parade Rd to Washington Ave	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Through-traffic and local residents impacted, but impacts may be minimised if traffic movements can be largely maintained – eastern verge is generally quite wide in this area	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future due to existing adjacent track/road, though traffic management may be required	Impacts of required approvals on project timeline expected to be minimal as long as vegetation clearing is minimal	**Manageable**
18	Washington Ave to Hay Park via Parade Rd	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Works will impact Parade Rd users. The impacts are likely to be more substantial along Parade Rd closer to the Bunbury CBD compared to further south	Access and topography along this option are preferable, though traffic and services will need to be managed. There is a WC Sewer Pump Station along this route which will also require management of access/services	Expected ease of access in the future due to existing adjacent road, however traffic management likely required	Impacts of required approvals on project timeline are expected to be manageable if vegetation clearing is minimal. However, note that this is not the City of Bunbury's preferred route, so this could result in approvals delays	**Manageable**
19	Hay Park Detour	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Works will impact users of Hay Park green open spaces and other public facilities within Hay Park complex, but it is assumed that this can be managed. Route preferred by City of Bunbury	Access and topography along this option are preferable. Rout greatly minimises traffic management, services crossings, etc. Impacts on playing fields and retic will need to be managed	Expected ease of access in the future as pipe will be within green open spaces	Impacts of required approvals on project timeline are expected to be manageable if vegetation clearing is minimal	**Unrestricted**
20	Washington Ave to Hay Park via Bussell Hwy	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	MRWA may not approve of this route following the highway	Congestion of existing services and verge width is an issue. Likely a high level of traffic management required. Risks due to high speed traffic	Extensive traffic management likely required for future access	Could have significant impacts on project timeline to gain MRWA approval	**Negotiable**
21	Hay Park to Bunbury Turf Club via Parade Rd (Minor)	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Local traffic and residences impacted, but impacts may be minimised if traffic movements can be largely maintained. Potential impact to local shopping complex	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future due to existing adjacent track/road, though traffic management may be required	Impacts of required approvals on project timeline expected to be manageable if vegetation clearing is minimal	**Manageable**
22	Hay Park to Bunbury Turf Club via Bussell Hwy	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Traffic impacted, but impacts may be minimised if traffic movements can be largely maintained and HDD can be utilised. Viability of route entirely dependent on locating the pipeline within Bunbury Turf Club land. City of Bunbury has indicated in-principle approval of this route	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future – with the exceptions of the roundabout crossings – due to existing adjacent track/road, though traffic management likely required	Impacts of required approvals on project timeline expected to be minimal as long as Bunbury Turf Club agrees to locating the pipeline in their land and vegetation clearing is minimal	**Manageable** (based entirely on locating the pipeline within the turf club property)
23	Bunbury Turf Club to Nuytsia Ave via Bussell Hwy	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Minimal traffic impacts expected. Viability of route entirely dependent on locating the pipeline within Bunbury Turf Club land. City of Bunbury has indicated in-principle approval of this route	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future due to existing adjacent track/road, though traffic management likely required	Impacts of required approvals on project timeline expected to be minimal as long as Bunbury Turf Club agrees to locating the pipeline in their land and vegetation clearing is minimal	**Unrestricted** (based entirely on locating the pipeline within the turf club property)
24	Hay Park to Nuytsia Ave via Brittain Rd	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Traffic impacted, but impacts may be minimised if traffic movements can be largely maintained and HDD can be utilised. Viability of route entirely dependent on locating the pipeline within Bunbury Turf Club land	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future – with the exceptions of the roundabout crossings – due to existing adjacent track/road, though traffic management likely required	Impacts of required approvals on project timeline expected to be minimal as long as Bunbury Turf Club agrees to locating the pipeline in their land and vegetation clearing is minimal	**Manageable** (based entirely on locating the pipeline within the turf club property)
25	Nuytsia Ave to Hands Oval via Blair St	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Substantial impact to road users along Blair St and local traffic and residences. City of Bunbury has indicated in-principle approval of this route	High level of traffic management required. Congestion of existing services and verge width could result in this route not being viable	Extensive traffic management likely required for future access	Impacts of required approvals on project timeline expected to be minimal as long as vegetation clearing is minimal	**Negotiable** (could be not viable depending on actual locations of existing services)
26	Nuytsia Ave to Hands Oval via Spencer St	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Local and through traffic and residences impacted. City of Bunbury has indicated in-principle approval of this route	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future due to existing adjacent track/road, though traffic management will likely be required	Impacts of required approvals on project timeline expected to be minimal as long as vegetation clearing is minimal	**Negotiable**
27	Nuytsia Ave to Gorman Loop via Little St	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Local traffic and residences impacted, but impacts may be minimised if traffic movements can be largely maintained	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future due to existing adjacent track/road, though traffic management will likely be required	Impacts of required approvals on project timeline expected to be minimal as long as vegetation clearing is minimal	**Negotiable**

28	Hands Oval to Forrest Park via Blair St	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Substantial impact to road users along Blair St and local traffic and residences	High level of traffic management required. Congestion of existing services and verge width could result in this route not being viable	Low access in the future due to likelihood that HDD is the only possible construction method	Impacts of required approvals on project timeline expected to be minimal as long as vegetation clearing is minimal	**Negotiable** (could be not viable depending on actual locations of existing services)
29	Gorman Loop Detour	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Local traffic and residences impacted, but impacts may be minimised if traffic movements can be largely maintained	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future due to existing adjacent track/road, though traffic management will likely be required	Impacts of required approvals on project timeline expected to be minimal as long as vegetation clearing is minimal	**Manageable**
30	Forrest Park via Biesiot St	No known threatened or priority species occur in this section of the route. Every effort will be made to avoid clearing of native vegetation thereby negating the requirement for a native vegetation clearing permit.	Local traffic and residences impacted, but impacts may be minimised if traffic movements can be largely maintained	Access and topography along this option are preferable, though traffic and services will need to be managed	Expected ease of access in the future due to existing adjacent track/road, though traffic management will likely be required	Impacts of required approvals on project timeline expected to be minimal as long as vegetation clearing is minimal	**Manageable**

6.2.2 Route option lengths/costs

The indicative lengths and costs for each route option are listed below. Costs have been estimated based on an average rate for the supply and laying of PVC-M pipe of sizes DN300, DN250, DN200, DN150 and DN100 ([redacted] respectively). The lengths of each size within the route options are dictated by the Distribution System Hydraulic Assessment Report Rev C (GHD, May 2021). The costs listed below do not take into account adverse ground conditions such as rock, dewatering, etc. nor do they allow for any HDD sections. The indicative costs are intended for high level comparison based on length only.

Table 8: Route option length and cost summary – remainder of Stage 1 (Parade Rd to Forrest Park)

Route option		Approx. length	Indicative cost
17	Parade Rd to Washington Ave (DN300)	730 m	[redacted]
18	Washington Ave to Hay Park via Parade Rd (DN300/DN250/DN200)	1,790 m	
19	Hay Park Detour (DN300/DN250/DN200)	2,000 m	
20	Washington Ave to Hay Park via Bussell Hwy (DN300/DN250/DN200)	2,890 m	
21	Hay Park to Bunbury Turf Club via Parade Rd (Minor) (DN200)	470 m	
22	Hay Park to Bunbury Turf Club via Bussell Hwy (DN200)	460 m	
23	Bunbury Turf Club to Nuytsia Ave via Bussell Hwy (DN200/150)	380 m	
24	Hay Park to Nuytsia Ave via Brittain Rd (DN200/150)	1,330 m	
25	Nuytsia Ave to Hands Oval via Blair St (DN150)	810 m	
26	Nuytsia Ave to Hands Oval via Spencer St (DN150)	1,080 m	
27	Nuytsia Ave to Gorman Loop via Little St (DN150)	890 m	
28	Hands Oval to Forrest Park via Blair St (DN100)	250 m	
29	Gorman Loop Detour (DN100)	140 m	
30	Forrest Park via Biesiot St (DN100)	190 m	

However, comparing the route option lengths individually does not help assess the overall length of each combination. There are a total of twenty six possible routes considered for the Stage 1 pipeline section as summarised in the following table.

Table 9: Possible pipeline routes for remainder of Stage 1 (Parade Rd to Forrest Park)

Pipeline route		Total length	Total cost
O	17 – 18 – 21 – 23 – 25 - 28	4,430	[redacted]
P	17 – 18 – 21 – 23 – 25 – 29 – 30	4,510	
Q	17 – 18 – 21 – 23 – 26 – 28	4,700	
R	17 – 18 – 21 – 23 – 26 – 29 – 30	4,780	
S	17 – 18* – 22 – 23 – 25 – 28	4,620	
T	17 – 18* – 22 – 23 – 25 – 29 – 30	4,700	
U	17 – 18* – 22 – 23 – 26 – 28	4,890	
V	17 – 18* – 22 – 23 – 26 – 29 – 30	4,970	
W	17 – 18* – 24 – 27 – 30	5,130	
X	17 – 18* – 24 – 27 – 29 – 28	5,330	
Y	17 – 19** – 21 – 23 – 25 – 28	4,520	
Z	17 – 19** – 21 – 23 – 25 – 29 – 30	4,600	
AA	17 – 19**– 21 – 23 – 26 – 28	4,790	
AB	17 – 19** – 21 – 23 – 26 – 29 – 30	4,870	
AC	17 – 19 – 22 – 23 – 25 – 28	4,630	
AD	17 – 19 – 22 – 23 – 25 – 29 – 30	4,710	
AE	17 – 19 – 22 – 23 – 26 – 28	4,900	
AF	17 – 19 – 22 – 23 – 26 – 29 – 30	4,980	
AG	17 – 19 – 24 – 27 – 30	5,140	
AH	17 – 19 – 24 – 27 – 29 – 28	5,340	
AI	17 – 20 – 22 – 23 – 25 – 28	5,520	
AJ	17 – 20 – 22 – 23 – 25 – 29 – 30	5,600	
AK	17 – 20 – 22 – 23 – 26 – 28	5,790	
AL	17 – 20 – 22 – 23 – 26 – 29 – 30	5,870	
AM	17 – 20 – 24 – 27 – 30	6,030	

Pipeline route		Total length	Total cost
AN	17 – 20 – 24 – 27 – 29 – 28	6,230	[redacted]

* Note that routes S, T, U, V, W and X involve a connection between route options 18 and 22 and 18 and 24 that are not shown in the maps in Appendix E and F. For these routes, the length of option 18 is increased by approximately 200 m to make up this connection. This is taken into consideration in the length and cost calculations above.

** Note that routes Y, Z, AA and AB involve a connection between route options 19 and 21 that is not shown in the maps in Appendix E and F. For these routes, the length of option 19 is reduced by approximately 120 m to make up this connection. This is taken into consideration in the length and cost calculations above.

As shown in Table 9, the possible pipeline routes are relatively similar in length and cost. However, there is an approximate 30% difference in both length and cost between the shortest route (O) and the longest route (AN), with an estimated cost difference of $0.6 M. Refer to the following section for further discussion regarding the route option comparison.

6.2.3 Comparison summary

The main constraints in the project area affecting the pipeline route options include existing services, existing subdivisions/businesses/residences/roads, and the constructability and operability issues that these impacts create. Due to the congested services and narrow verges in several route options explored, only route options 19 and 23 are considered “unrestricted”. Spatial constraints, impacts to the public and road crossings result in many of the overall routes being including options with “manageable” ratings. And in some areas, congestion and impacts are at such a level that the routes are considered “negotiable”, with some bordering on “not viable”.

In the south, route option 17 along Parade Rd to Washington Ave is the only route considered, and it is considered “manageable”. This route option is therefore adopted.

Between the Parade Rd/Washington Ave intersection and the Parade Rd/Brittain Rd intersection, there are three main options: 18 (Parade Rd), 19 (Hay Park) and 20 (Bussell Hwy). The Hay Park option (19) is the only one categorised as “unrestricted” and is therefore preferred. The City of Bunbury has indicated a preference for this route.

Between the Parade Rd/Brittain Rd intersection and Nuytsia Ave, running along either side of the Bunbury Turf Club appears suitable (manageable/unrestricted), but only if the turf club allows the pipe within its property.

The main drawback with the route following options 24 (east side of the turf club) (and 27, Little St and other residential streets east of Blair St) is that it is longer, and also takes the pipeline further from Hands Oval, to which a connection will still be required. These factors will likely mean an increased cost.

Determination of the preferred option between Nuytsia Ave and Forrest Park is the most difficult, as the majority of the routes in this area are classified as “negotiable” with the exception of some of the smaller local roads at the northern end. Considering the issues, it seems apparent that the Blair St route options (25 and 28) should be discounted based on the significant constructability issues and impacts on traffic/residents and the fact that they border on “not viable”. However, determining the preferred route between the remaining options west (26, Spencer St) and east (27, Little St, etc.) is not straightforward.

There is expected to be a higher level of social impacts associated with constructing the pipeline along Spencer St (26) compared to the residential streets on the east side of Blair St (27, Little

St, etc.). While the Spencer St is longer than the Little St option, the requirement for an offtake to Hands Oval for the eastern route option would make up this difference. However, the per-metre construction cost is likely to be higher along Spencer St, due to the larger traffic volumes and congestion of services. However, it should be noted that the use of the Little St route requires the use of route option 24 (eastern side of the turf club), which adds 500 m to the overall route. All things considered, the additional length of the eastern route could be offset by the constructability issues of the western route.

Route options 29 and 30 along Gorman St and Biesiot St both appear manageable and appropriate, particularly compared to the Blair St option (28).

Based on the above discussion, the recommended route follows Parade Rd to Hay Park (17), then runs within Hay Park (19), then crosses Bussell Hwy and Brittain Rd. From there, there appear to be two viable options that both present issues. Both run within the turf club property, either on the west side (22 and 23), or on the south and east sides (24). The pipeline will then run north via local roads either west (26, Spencer St) or east (27, Little St. etc.) of Blair St. It will finish by running north via Biesiot St to Forrest Park. These two options constitute routes AF (4,980m via Spencer St) and AG (5,140m via Little St etc.) Based on constructability/ operability issues, the Little St option (AG) appears slightly more favourable and is recommended. However, the differences between AF and AG appear relatively minimal from a technical perspective. It is recommended that both options be discussed with the turf club (regarding the acceptability of either/both routes within their property), Geographe Civil (regarding a comparison of constructability and cost between the options) and the City of Bunbury (regarding a comparison of impacts on roads and residents between the options) to confirm the preferred route north of Parade Rd.

6.3 Recommended pipeline route

As a result of the assessment undertaken, the preliminary recommendation for the Stage 1 pipeline is route AG (17 – 19 – 24 – 27 – 30). This route appears the most viable in terms of environmental, constructability, future operability/maintenance, and project timeline factors compared to the other options, though route AF (17 – 19 – 22 – 23 – 26 – 29 – 30) has similar constraints and merits.

This recommendation is based on the information obtained to date. It is recommended that further information gathering and consultation with authorities/stakeholders be undertaken to confirm the viability of this route and its preference over the other viable options as discussed in the previous section.

The key obstacles for the Stage 1 pipeline are expected to be landowner approvals (particularly from the Bunbury Turf Club) and managing social impacts.

6.4 Further recommended action

The recommended actions to confirm the preferred pipeline route option and its viability and to progress the pipeline design include:

- Walk the route with Geographe Civil to obtain further constructability input;
- Liaise with Bunbury Turf Club regarding the proposal to locate the pipeline within their property and explore route/alignment options;
- Liaise with the City of Bunbury regarding construction along shire roads and issues such as reinstatement requirements and limiting impacts to residents;
- Liaise with the City of Bunbury regarding construction within Hay Park;

- Undertake service locating in key locations to determine a viable alignment for the new pipeline;
- Instigate other site investigation work such as topographical and feature surveys, geotechnical investigations, etc. along the proposed route; and
- Request to authorities that any future proposals by others along the proposed route be made known to Aqwest for discussion prior to implementation. This is particularly applicable to where the pipe runs in road reserves, where land rights cannot be obtained/the route cannot otherwise be secured prior to construction.

Appendices

Appendix A – Shared Stage 1 & 2 Section – Pipeline Route Options

Paper Size ISO A3

0 200 400 600 800 m

Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

GHD

Aqwest

Aqwest Bunbury WRRS EPCM

Pipeline Route Selection - Stages 1 and 2
Section Shared Between Stages 1 and 2 - Route Options

Project No. 12537061
Revision No. A
Date. 25/03/2021

APPENDIX A

Document Path: G:\61\12537061\12_GIS\Maps\Working\12537061_RK_Working2.mxd

Print Date: 25/03/2021

Data Source: G:\61\12537061\12_GIS\Maps\Working

Created By: Rei Kristanto

Appendix B – Shared Stage 1 & 2 Section – Traffic Light Map

Paper Size ISO A3

0 200 400 600 800 m

Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

Aqwest

Aqwest Bunbury WRRS EPCM

Pipeline Route Selection - Stages 1 and 2
Section Shared Between Stages 1 and 2 - Traffic Light Map

Project No. 12537061
Revision No. A
Date. 25/03/2021

APPENDIX B

Document Path: G:\61\12537061\12_GIS\Maps\Working\12537061_RK_Working2.mxd

Data Source: G:\61\12537061\12_GIS\Maps\Working

Print Date: 25/03/2021

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Appendix C – Stage 2 Section – Pipeline Route Options

Paper Size ISO A3

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Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 184j
Grid: WGS 184j Web Mercator Auxiliary Sphere

Aqwest

Aqwest Bunbury WRRS EPCM

Pipeline Route Selection - Stages 1 and 2
Stage 2 Pipeline - Route Options

Project No. 12537061
Revision No. A
Date. 16/04/2021

APPENDIX C

Document Path: G:\61\12537061\12_GIS\Maps\Working\12537061_RK_Working2.mxd

Data Source: G:\61\12537061\12_GIS\Maps\Working

Print Date: 16/04/2021

Created By: Rei Kristanto

Appendix D – Stage 2 Section – Traffic Light Map

Paper Size ISO A3

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Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 184j
Grid: WGS 184j Web Mercator Auxiliary Sphere

A7qwes

A7qwest BunBtr y WWR EPSM

PipwliuwWoBswRwlwcsiou - Rsagwe Caud 4
Rsagw4 Pipwliuw- WoBswOpsioue

Project No. C4253/ 1C
Revision No. A
Date. C16 06l/ 4C

APPENDIX D

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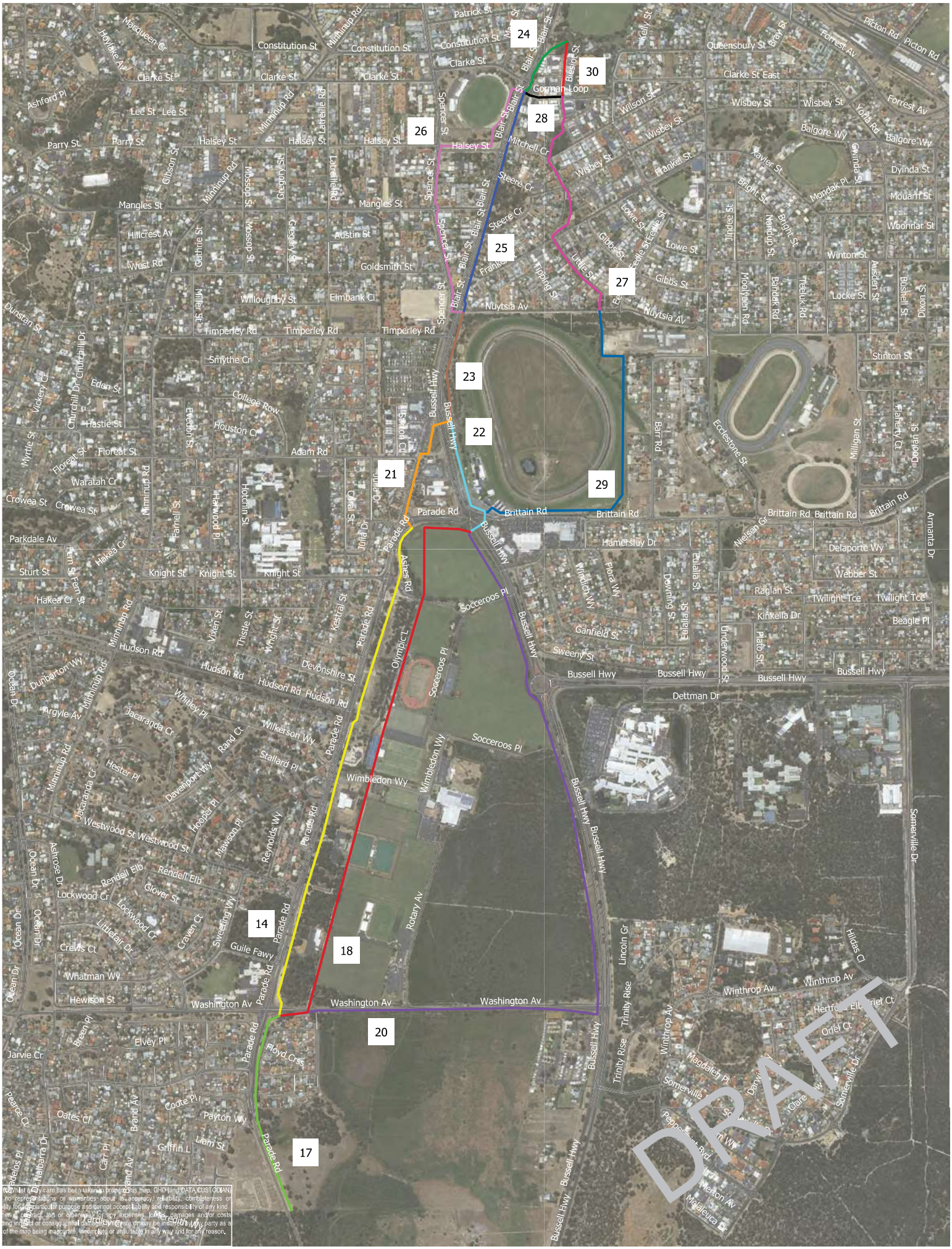
Appendix E – Stage 1 Section – Pipeline Route Options



Paper Size ISO A3

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Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

GHD

Aqwest

Aqwest Bunbury WRRS EPCM

Pipeline Route Selection - Stages 1 and 2
Stage 1 Pipeline - Route Options

Project No. 12537061
Revision No. A
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APPENDIX E

Document Path: G:\61\12537061\12_GIS\Maps\Working\12537061_RR_Working2.mxd
Print Date: 08/06/2021

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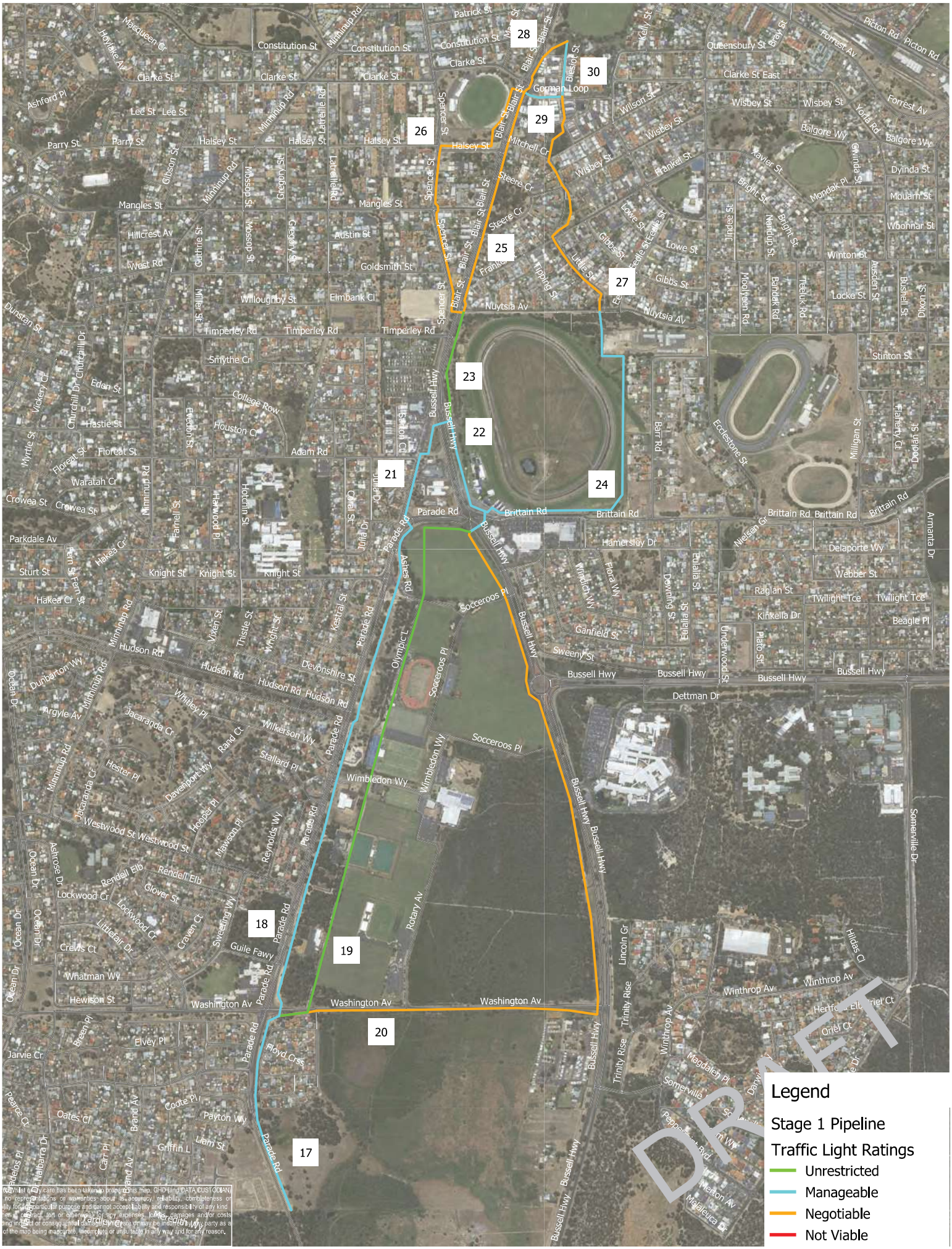
Appendix F – Stage 1 Section – Traffic Light Map



Paper Size ISO A3

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Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 18j 4
Grid: WGS 18j 4 Web Mercator Auxiliary Sphere

Aqwest

Aqwest Bunbury WRRS EPCM

Pipeline Route Selection - Stages 1 and 2
Stage 1 Pipeline - Traffic Light Map

Project No. 12537061
Revision No. A
Date. 08/06/2021

APPENDIX F

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https://projectsportal.ghd.com/sites/pp18_01/aqwestbunburywrrsepc/ProjectDocs/12537061-REP-A-Aqwest Pipeline Stage 2 Route Assessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
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B						
C						[redacted] ed by Peter Crisp 6.16 14:08:58

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