Figure 3-4A: Integration Pipeline

N

Scale 1:35,000 at A3

0 0.5 1 km

Coordinate System: GDA 1994 MGA Zone 50

Date: 18/03/2019

Legend

Development Area Footprint

- ASDP Site
- Pipeline
- Northern Route Option
- Integration Pipeline
- Major road
- Minor road

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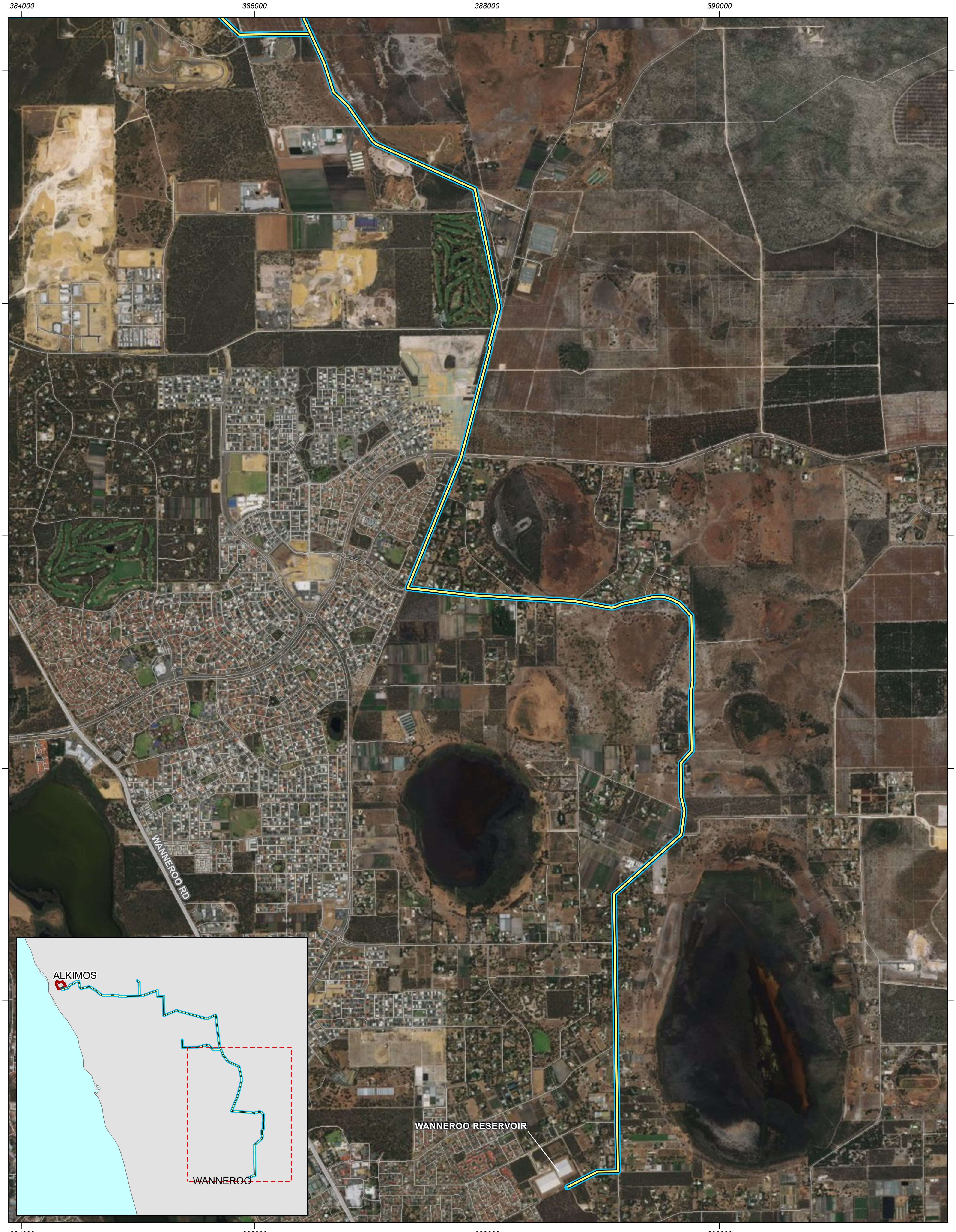

Figure 3-4B: Integration Pipeline

N

Scale 1:30,000 at A3

0 0.5 1 km

Coordinate System: GDA 1994 MGA Zone 50

Date: 13/03/2019

Legend

Development Area Footprint

- Pipeline
- Integration Pipeline
- Major road
- Minor road

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3.3 Staging

3.3.1 Pilot plant

A pilot plant investigation involves a small-scale simulation of the seawater desalination plant process to provide useful scientific and engineering data on seawater quality and the performance of various treatment technologies to optimise design and delivery of the Proposal.

This type of investigation may be necessary for the SDP to:

- gain continuous data on local seawater quality
- perform process investigations to select preferred pre-treatment technology
- confirm parameters for process design purposes.

The pilot plant investigation would be performed at a small scale and require the installation of temporary seawater intake and possible return lines. These would be constructed in small diameter (less than 350 mm diameter) polyethylene pipe using trenchless technology, such as horizontal directional drilling, or laid temporarily on the seabed with a buried shore crossing.

The seawater feed would be either direct piped to the pilot plant from a temporary pump station or pumped to a temporary seawater tank (10 kL or less) supplying the pilot plant.

A containerised modular pilot plant would be temporarily installed to house the process equipment to be trialled. This modular plant will require a source of power, either from mains supply or temporary generator.

The treated and reject streams from this plant would be combined prior to disposal back to the ocean either via a new return line or via connection into the existing WWTP outfall. All return flows to the ocean will comply with water quality conditions defined for the future full-scale plant. Under most trials, the combined stream discharged back to the ocean will effectively be equivalent to the quality of seawater drawn from the ocean.

Timing of the pilot plant investigation would follow the receipt of relevant approvals and would extend for an operating period of up to 12 months. Preferably, the construction of marine works (intake and return lines) associated with the pilot plant would occur during an autumn period when sea and weather conditions are most favourable.

The pilot plant would have no impacts over and above the full Proposal being referred.

3.3.2 Alkimos Seawater Desalination Plant staging

The SDP is proposed to be developed in four 25 GL per annum stages as per Table 3-2. It is possible that two stages may be merged to meet supply requirements. The actual timing of each stage will be based on actual growth in water demand, potential groundwater allocation reduction, actual streamflow conditions and timing of other source option development (e.g. construction of the proposed PSDP2 at Kwinana).

Table 3-2: Seawater Desalination Plant estimated staging

Stage	Capacity	Marine works	Pipeline integration
1a	25 GL/a SDP + 6.6 GL/a GWTP	100 GL/a	50 GL to Wanneroo Reservoir
1b	50 GL/a SDP		50 GL to Wanneroo Reservoir
2a	75 GL/a SDP		100 GL to Forrestfield Reservoir
2b	100 GL/a SDP		100 GL to Forrestfield Reservoir

3.4 Construction

3.4.1 Enabling works

Alkimos is currently one of the fastest growing suburbs in Perth and has a number of significant residential, commercial and infrastructure developments planned to be complete by 2023 (Figure 3-5). Several of these developments either border the existing Water Corporation cadastral boundary or are located along the proposed route of the integration pipeline.

To eliminate potential impacts on the community, Water Corporation is considering an early works package, which will include a subset of the ultimate works for this source development:

- site earthworks and revegetation
- integration pipeline construction
- power supply to site.

The earthworks required for the ASDP site will result in generation of a significant volume of fill material to achieve the concept design levels that will lower the plant to the levels of the existing WWTP. To minimise interruptions to nearby residents and to ensure the proposed western berm is completely established and revegetated prior to land development commencing to the west of the site, there are advantages in completing the earthworks prior to the first stage of the SDP being required.

There are also opportunities and benefits associated with the early construction of a section of the pipeline between the site and Wanneroo Road to align with planned major infrastructure upgrades (e.g. Metronet and road extensions).

The decision to progress these early works has not yet been made and will depend on future planning. However, the enabling works may be progressed to minimise impact to the local community and to align with other infrastructure upgrades.

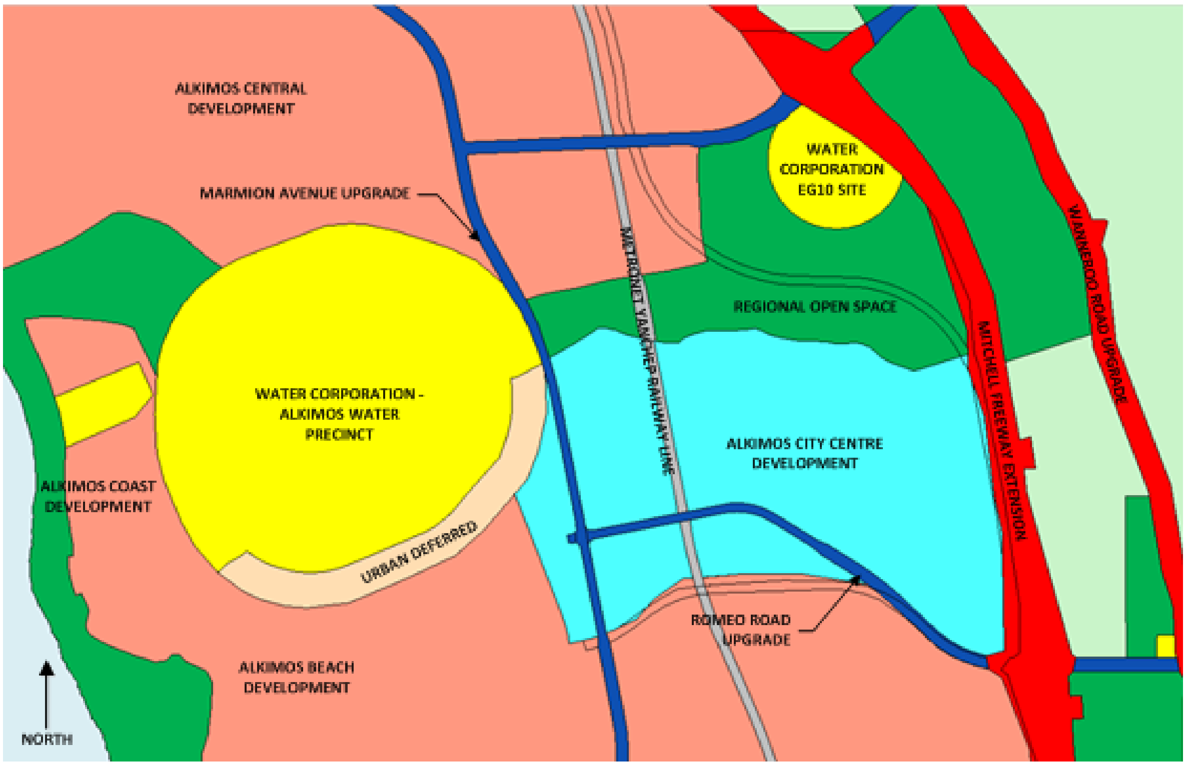

Figure 3-5: Alkimos development overview

3.4.2 Marine infrastructure

The Proposal requires the installation of two seawater intakes and two seawater return outlets. The intakes and outlets will be secured to vertical marine risers, that will in turn be connected to separate subsea tunnels. The design, positioning and construction of the intakes, outlets and subsea tunnels were carefully considered during the selection process, including:

- alignment of the SDP intake and outfall tunnels such they do not impact the existing Alkimos WWTP outfall pipe
- separation of the SDP intake and outfall points to avoid recirculation of the brine
- separation of the SDP intake and WWTP outfall to avoid drawing of treated wastewater to the SDP intake
- separation of the SDP outfall and WWTP outfall to minimise overlap of the respective plumes – to avoid complicating monitoring requirements and compliance with existing conditions
- use of a TBM to drill beneath sensitive marine habitats
- location of the SDP intake in a sufficient water depth to allow:
  - minimum depth from seabed
  - minimum depth from low tide surface level
  - effective brine dilution
- positioning of intake and outfall infrastructure in open sandy habitats away from sensitive marine habitats i.e. seagrasses and macroalgal communities.

Marine tunnels

Several construction methodologies are available to install the marine pipelines. The proposed installation method is via tunnelling using a TBM to the chosen intake and outfall locations, launched from within Water Corporation's lot boundary.

Tunnelling was chosen to minimise environmental impacts and has the following advantages:

- no clearing or impact to the dune system outside Lot 1050
- no impact to the offshore reef and benthic habitat (except for connecting the structures at the end of each pipeline)
- minimal sediment plume dispersion in the marine environment
- minimal community disruption (a small section of beach may be required for a minimal period)
- reduced risk in terms of construction timeline (open trenching can only progress under suitable weather and sea conditions, which is limited to a short period of the year).

Tunnelling will commence with the excavation of two 18 m diameter vertical shafts within the ASDP site. Two 3.5 m diameter tunnels (one for the intake and one for the outfall) will subsequently be driven due west from the vertical shafts at a minimum horizontal depth of 7 m beneath the seabed. The final horizontal and vertical alignment of the tunnels remains subject to detailed engineering design. The marine tunnels, intakes and outlets have been designed to accommodate the maximum plant capacity at the ultimate SDP development of 100 GL/a meaning only a single marine construction campaign is required, minimising impacts on the community and the environment.

Steel Fibre Reinforced Concrete (SFRC) will be used to construct the tunnel lining behind the TBMs. A self-supporting ring of six segments will be erected in each cycle in a shield behind the TBM, and grout will be injected into the annulus of the ring to lock it in place, to provide a stable and waterproof tunnel lining. Temporary bolts will be used to provide additional security during erection by tying the segments together. Bolt holes will later be grouted to provide a smooth internal bore.

Upon completion of tunnelling, the TBMs will either be encased in concrete and abandoned or dismantled. Abandonment is the more likely option, given the dismantling and recovery processes are often hazardous and the cost of recovery typically exceeds the value of the TBMs. If the TBMs are abandoned, the internal parts will be stripped out before abandonment. The final decision on the fate of the TBMs will be made prior to tunnel construction.

Marine risers

Vertical risers of 2 m diameter will be installed at the end of the tunnels using a temporary jack-up barge. Both risers will be installed and connected to the tunnel by grouting and boring a lateral connector pipe. The marine intake structures will be circular, approximately 8.5m in diameter, with screening around the perimeter to minimise entrainment of marine biota and debris. Wherever practicable, risers will be installed at a suitable distance from reef habitats to avoid the risk of smothering or physical damage.

Each completed riser will have a 2 m diameter liner and be at least 14 m deep depending upon the depth of the final tunnel alignment. Typically, the marine risers will be offset from the tunnel by approximately 6 m to provide working room for the adit connection. Risers will be constructed by drilling into the seabed to the required depth from within a casing. The casing is a temporary structure designed to support the sediments around the bore during the drilling process. On completion, the casing will be cut off at seabed level or, if required, extended in height at the surface of the water column to contain excavated material and prevent a plume forming. Once drilling is complete the casing will be removed and the riser liner lowered into the bore, positioned correctly and then grouted into position. Once fixed, the liner will be sealed and dewatered in preparation for connection to the tunnel.

Intake

Following installation of the vertical risers, the intake structures will be lowered and secured to the top of the risers. It is anticipated that each structure will be approximately 8.5 m in diameter to provide a clear opening and allow for fixing of screens over the openings (Figure 3-6). The final size will be dependent upon the hydraulics and planning of the plant. This size will limit the horizontal intake velocity of each screening structure to 0.1 m/s, which is the velocity shown to minimise risk of marine life entrapment. The intake openings will be positioned approximately 2 m above seabed to limit entrainment of seabed material, such as seagrass wrack and detached macroalgae.

The diffuser structures will be constructed using reinforced concrete and anchored to the seabed over the mouth of each riser. Seabed preparation will be required to found the base of the intake structures and ground anchors may also be required to restrain the structures. Given the mass of the structures and limits on crane loads, it is expected that they will be cast in suitable sized sections and lowered into place and fitted together on the seabed. The connections for the sections will be simple and robust to reduce the complexity of diving operations with any bolted connections being oversized.

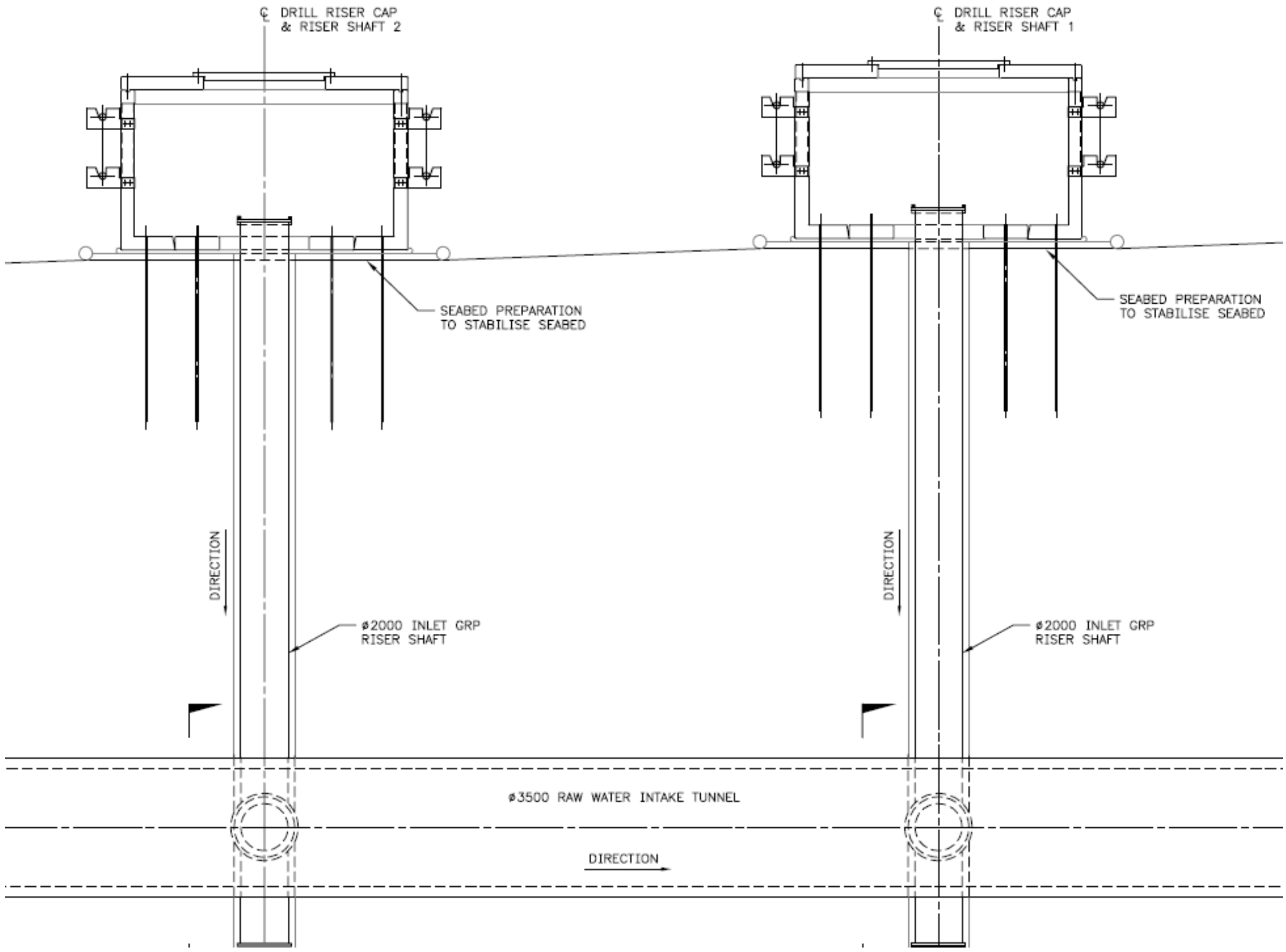

Figure 3-6: Intake structure concept design

Outfall

Hydrodynamic modelling determined that two rosette style diffusers positioned 4.4 km west of the SDP were sufficient to achieve the minimum performance criteria, including at least a 1 in 30 dilution in the near field zone.

Each rosette structure will be approximately 7 m in diameter (Figure 3-7). The outfall structures will be manufactured using reinforced concrete with enough mass or anchoring to prevent movement in the wave and current loads. As with the intake structures, the outfall structures will need to be cast in sections and fitted together on the seabed to reduce crane lifting requirements. Wherever practicable, the outlet risers and rosette diffusers will be installed at an appropriate distance from reef habitats, to avoid the risk of smothering or physical damage.

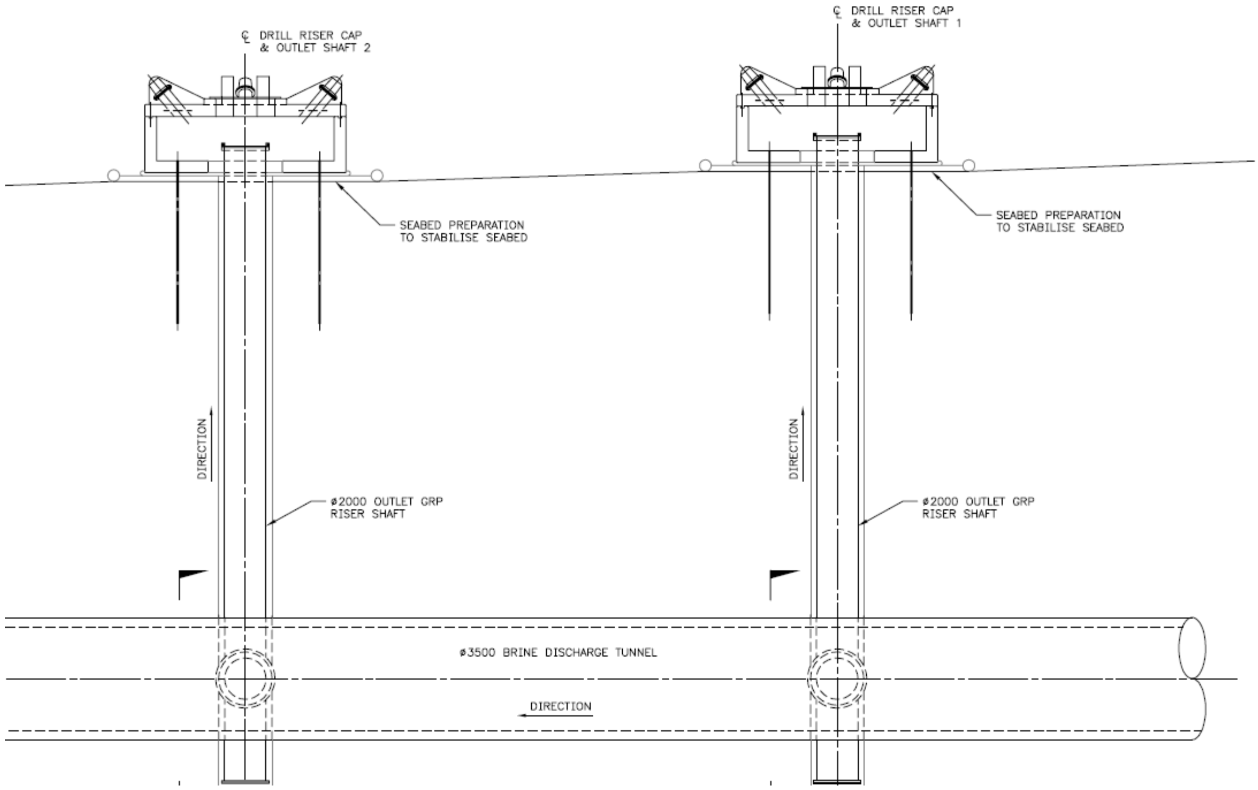

Figure 3-7: Rosette diffuser concept design

3.4.3 ASDP infrastructure

The ASDP site for the ultimate 100 GL/a facility covers 29 ha (Figure 3-2). The staging for the site considers future laydown requirements to enable construction without adversely affecting the operation of the existing plant operations. A conceptual layout of the ASDP site is shown in Figure 3-8 and Figure 3-9.

In order to minimise visual and noise impacts to the surrounding community, substantial earthworks are required. This includes excavation and disposal of a significant volume of fill which will be used for required levels and the construction of a berm on the western boundary. Once complete there will be a surplus of approximately 600,000 m^3 of material that will be required to be moved offsite via road transport and provided to an approved end user.

As discussed previously, the earthworks and revegetation required for the ultimate 100 GL/a plant is planned to be installed either during or prior to the construction of the first 25 GL/a stage to avoid disruption of the community in the future when the potential impacts may be greater due to further residential development.

The ASDP site will be cleared of vegetation which will be mulched on site and either used in revegetation works (if suitable) or will be provided to an approved end user for re-use.

Once earthworks are complete, the western berm will be stabilised to prevent wind erosion and revegetated with native vegetation. The proposed plant footprint will be stabilised using native grasses until construction commences.

Figure 3-8: Model of ASDP indicative site layout (full plant capacity)

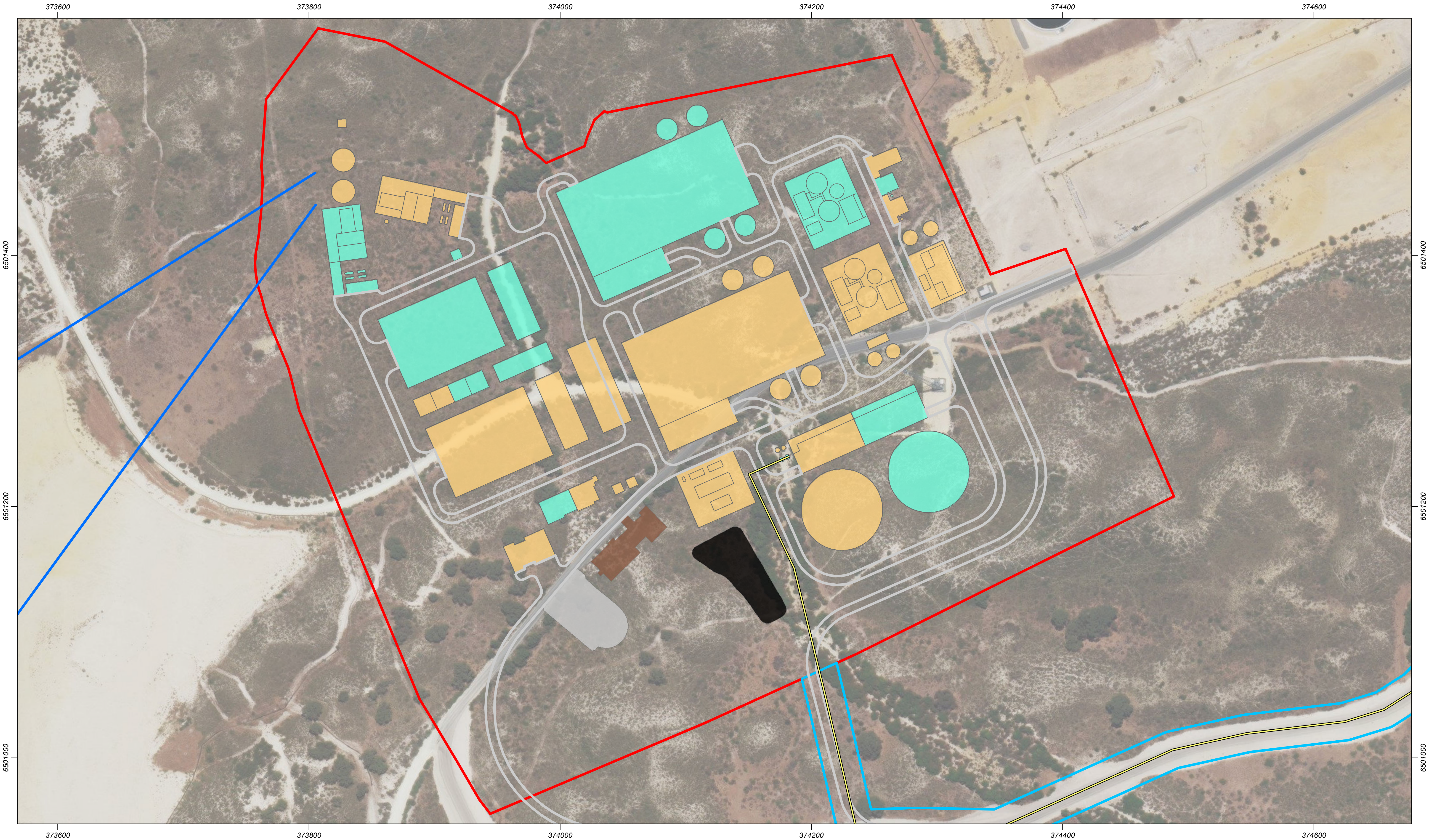

Figure 3-9: ASDP indicative site layout

Legend

Integration Pipeline
Marine Tunnel
Buildings
Roads

Development Area Footprint
ASDP Site
Pipeline
100GL stage

50GL stage
Administration and operation building
Pads base
Parking

N

Scale 1:2,750 at A3

0 50 100 m

Coordinate System: GDA 1994 MGA Zone 50
Date: 18/03/2019

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