

## 9. Detailed Description of the Effluent Pipeline

A detailed discussion of the effluent treatment process is provided in Volume 2 of the Draft IIS. A summary of the effluent sources, treatment, emission limits, transport and disposal is provided below to provide context for the assessment of the effluent pipeline contained in this section.

### 9.1 Sources of Effluent

There are five sources of liquid effluent: the pulp mill process, sanitary sewage, leachate from the solid waste disposal site, any stormwater and any minor chemical spills.

### 9.2 Effluent Collection, Treatment and Disposal

#### 9.2.1 Process effluent

The mill's effluent treatment plant will treat an average of 73 Ml of process effluent per day.

The effluent treatment process consists of neutralisation, coarse screening, primary clarification, equalising, cooling, chlorate removal, activated sludge biological treatment with aeration, secondary clarification and discharge of treated water.

The effluent treatment plant will be a modern primary and a secondary effluent treatment facility with numerous other components such as pre-treatment units, cooling towers, nutrient dosing and aeration equipment.

The control parameters listed in the 2004 RPDC Emission Limit Guidelines will be achieved through the advanced treatment process, modern in-plant control measures and environmentally acceptable pulp bleaching process (Jaakko Pöyry, 2006).

A detailed description of the effluent treatment process is provided in section 6.4.14 of Volume 1.

#### 9.2.2 Sanitary Effluent Treatment

It is estimated that the total amount of sanitary sewage (including canteen effluent and shower water) will be approximately 100 cubic metres per day. The sewage will be treated in a standard septic tank system and pumped to the inlet of the process effluent treatment plant. Sewage will be a source of nutrient for micro-organisms in the effluent treatment plant.

#### 9.2.3 Stormwater Treatment and Disposal

Storm water will be directed through two separate systems, one for rain water and the other for surface run-off water. The surface run-off drainage system will be fitted with a first flush holding basin and a spill basin to deal with potential contamination by floating debris and accidental spills (Jaakko Pöyry, 2006). All surface run-off and drainage is eventually directed to the effluent treatment plant.

#### **9.2.4 Effluent from Chemical Plant**

Two effluent pumps will be provided in the chemical plant. Equipment wash water and contaminated effluents from banded areas will be sent to the drainage system. Sump pumps will transfer the effluent to the alkaline and acid neutralisation tanks for rapid pH neutralisation and discharge to the effluent treatment plant (Jaakko Pöyry, 2006).

#### **9.2.5 Spill Collection**

The pulp mill will have a spill monitoring, collection, containment and recovery system. If spillages occur in the digestion plant, the screening plant, and during washing (fibres and black liquor), in the evaporation plants and from tanks and during causticising (white liquor, weak liquor and lime), they are collected and returned to the respective process (Jaakko Pöyry, 2006).

In order to prevent sudden peaks of loading and occasional upsets in the external effluent treatment plant, large buffer tanks will be available for the storage of spilled cooking and recovery liquors. Spills will be recovered from tank overflows, mechanical breakdowns, operator errors and maintenance activities. From each process department a decision will be made as to which streams spills are suitable for recycling and which streams are to go directly to the effluent treatment plant. This decision will be based on conductivity, pH and other factors.

All critical process areas will be banded to avoid concentrated or harmful streams entering the external drainage system. These critical areas are:

- ▶ Liquor and washing liquor tanks in the unbleached fibreline area;
- ▶ Tall oil and turpentine handling;
- ▶ Evaporator tank farm;
- ▶ Causticising tank farm;
- ▶ Chemical plant tank farm;
- ▶ Recovery boiler; and
- ▶ Evaporator plant.

### **9.3 Effluent Emission Limits**

The Resource Planning and Development Commission *Recommended environmental guidelines for any new bleached eucalypt kraft pulp mill in Tasmania, Volume 2*, (RPDC 2004), established the monthly average and daily discharge effluent limits for any new pulp mill discharging to the environment as follows:

**Table 9-1 Liquid Effluent Limits**

	<b>TSS</b>	<b>BOD<sub>5</sub></b>	<b>COD(Cr)</b>	<b>AOX</b>	<b>Colour</b>
	<b>kg/ ADt</b>	<b>kg/ ADt</b>	<b>kg/ ADt</b>	<b>kg/ ADt</b>	<b>kg/ ADt</b>
Monthly Average Maximum	2.6	2.1	20	0.2	42
Daily Maximum	4.5	3.6	34	0.4	72

The effluent from the pulp mill must also comply with the requirements issued by the ANZECC Guidelines (2000). These Guidelines list the maximum allowable ambient concentrations for environmental risk chemicals discharged into the marine environment.

The plant is designed to treat the raw effluent load to a final effluent load at the average production of 3,143 ADt/d at the pulp mill as follows:

**Table 9-2 Average Raw and Final Effluent Loads**

<b>Parameter</b>	<b>Raw Effluent</b>		<b>Final Effluent</b>	
	<b>kg/ADt</b>	<b>t/d</b>	<b>kg/ADt</b>	<b>t/d</b>
Effluent Flow	23,000	72,300	20,317	63,770
TSS	8.4	26.4	0.41	1.3
BOD5	12.5	39.3	0.22	0.69
COD(Cr)	39.2	123	0.94	23
AOX	0.49	1.54	0.14	0.44
Colour (Note 1)	10	47.1	10	31.4
TDS	74	232	38.5	121
Chlorate	1.5	4.71	0.19	0.119

(Source: Jaakko Pöyry, 2006).

Notes: 1. The effluent colour may be lower than the estimated load above depending upon the final process conditions (eg: the actual kappa number and the C10<sub>2</sub>-charge).

### 9.3.1 Comparison of Effluent Emissions with Guidelines and Standards

In Table 9-3 the preliminary emissions of the pulp mill are compared with the Tasmania Draft Guidelines, US-EPA cluster rules and the BAT level proposed by the International Pulp and Paper Commission (IPPC) Bureau of the European Union:

**Table 9-3 Comparison of Emission Guidelines with EU BAT Guidelines, Raw Effluent Loads, and the required removal Efficiencies to Achieve the Guidelines**

Parameter	Emission Guideline Monthly average	EU Annual average	Raw effluent load	Required removal efficiency (%)
TSS, kg/ADt	2.6	0.6 – 1.5	8.4	80.5
BOD <sub>5</sub> , kg/ADt	2.1	0.3 – 1.5	12.5	86.6
COD, kg/ADt	20	8 - 23	39.2	56.1
AOX, kg/ADt	0.2	(0) - 0.25	0.49	56.8
Colour, kg/ADt	42	n/a	10	zero

(Source: Jaakko Pöyry, 2005).

The RPDC Emission Guidelines also define, in addition to the above indicated parameters, the following treated effluent parameters.

**Table 9-4 The Comparison of the RPDC Emission Guidelines and the Treated Effluent**

Parameter	Emission Guidelines	Treated effluent load
Acute toxicity, LC50/EC50	a)	no acute toxicity
Chronic toxicity, EC50	b)	e)
2,3,7,8-TCDD, pg/L	10	less than detection limit
2,3,7,8-TCDF, pg/L	30	less than detection limit
Chlorate, c) d), mg/L	10	less than 10
Trihalomethanes including chloroform, d)	d)	f)
Oil and grease	No visible contamination	No visible contamination

Notes:

- a) Acute toxicity should be measured in 100% effluent. The effect from the effluent should be less than 50%.
- b) Chronic toxicity should be measured in effluent at various dilutions above and below the dilution expected at the edge of the mixing zone. The concentration at which a 50% effect is obtained should be determined. The lowest observed effect concentration (LOEC) and the no observed effect concentration (NOEC) should also be determined. The discharge limit will be set such that the NOEC is not exceeded at the edge of the mixing zone.
- c) If the proponent proposes to use the ECF bleaching method in the mill process, the environmental impact assessment must include a study of the effects of chlorate ion on any sensitive marine flora and fauna species living within a 1 kilometre radius of the proposed discharge point for treated mill effluent. The discharge limit for chlorate will be set based on the results of this study so that no detectable environmental damage occurs beyond the dilution zone. Laboratory tests suggest that concentrations required to protect brown algae are less than 10 µg/L [Rosemarin et al. 1986]. It is strongly recommended that the EIS include specific study of the effects of appropriate levels of chlorate on algal communities in the particular discharge zones.

- d These limits are not applicable to BEK pulp mills employing a TCF bleaching sequence.*
- E The chronic toxicity is handled in a separate report. The chronic toxicity of the effluent will not differ from the modern mill chronic toxicity levels.*
- f) Some amount of trihalomethanes may form in case of hypochlorite is used in bleaching. In this mill hypochlorite is not used and trihalomethane content will be negligible.*

Due to the low raw effluent loads achievable with modern BAT-level in-plant control measures, such as is incorporated in the design of the pulp mill, both the RPDC and the EU guidelines will be achieved.

## **9.4 Pipeline Alignment**

The onshore alignment has been designed to avoid the area south of Aerodrome Road which has been identified as being environmentally sensitive (refer Sections 10.13 and 10.13), and a technically suitable stringing and launching site has been identified approximately 1 km onshore (Attachment 3 of Appendix 52, Volume 16). The alignment has been curved to avoid impact on the areas of threatened flora species as well as an Aboriginal heritage site.

## **9.5 Climate Change Risks**

The potential risks to the shore crossing from climate change effects have been assessed by Pitt and Sherry (2006c), and are described below. These have been considered in the engineering design.

### **Sea level rise**

As a result of sea level rise the level of wave attack on the existing coastline will be raised, resulting in existing areas being exposed to more consistent wave attack over time and new areas becoming exposed to wave attack.

This will result in some change in the location and form of the beach and cutting back of the existing foredune. Undercutting and destabilisation of these dunes will result in the loss of vegetation cover, increased mobility of the dunes and an increase in the incidence of blowouts.

The amount and spatial variation of sediments on the existing wave cut platform may be significantly altered over time but there is unlikely to be any significant alteration of the platform surface. Coastal recession is only likely to strip the overlying dunes and some of the Tertiary sediments off this platform.

### **Increased storminess**

Increased storminess would result in larger, more energetic waves reaching the back of the beach more frequently, leading to greater impact on the back of the beach and the dunes. Compounding this, an increase in the intensity of barometric depression results in an effective sea level rise of approximately 1 cm for each 1 hPa reduction in pressure<sup>11</sup>.

With greater frequency of storm events, the beach may not have time to replenish and rebuild between storms. As a result, subsequent storms would have greater impact on the coastline, leading to increased rate of coastal recession.

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<sup>11</sup> NSW Government (1990) NSW Coastline Management Manual.

A severe storm event could result in the removal of most or all of the sand on the existing beach, with the area being stripped back to the wave-cut platform surface on the highly to extremely weathered basalt. The wave cut platform is unlikely to be significantly eroded during any one particular storm event.

### **Fluvial processes**

The creek draining onto the beach at the western end, near Four Mile Bluff, has a very small catchment area. The time of concentration for any storm event will be small because of the small size of the catchment and flow will drop off rapidly following cessation of the rainfall event.

Infiltration capacity of the dunes may be relatively high initially, depending on vegetation cover and previous rainfall events but if the rainfall intensity is greater than the infiltration capacity, runoff will occur. Runoff will drop off rapidly once a rainfall event ceases, but flow in the creek will be temporarily augmented by the increased outflow from the raised watertable.

Potential increased creek flow associated with storm events will probably not be sufficiently high to cause erosion where areas are well vegetated. However, as the estimated velocities within the creek channel for all storm events exceed the minimum velocity required for the erosion of fine sand, unvegetated or sparsely vegetated areas will be prone to significant fluvial erosion during storm events.

### **Shoreline recession**

Sea level rise is likely to result in ongoing recession of the coastline in this area. This recession will involve ongoing truncation of the existing foredune and continued erosion of the underlying Tertiary sediments. The underlying basalt platform may be exposed as the foredune and sediments are removed but it is unlikely to be significantly eroded. The potential rate of erosion of the unconsolidated dune sands is likely to be reduced in this area by the presence of the underlying consolidated and semi-consolidated sediments. As a result ongoing coastal recession in this area may be less than might be expected.

The foredune on the eastern end of the beach, where the underlying Tertiary sediments are less prominent or absent and the dune is much lower, may be cut back more rapidly than on the western end near Four Mile Bluff.

The apparent variability in the rate of coastal recession over the last 60 years shown in photos in Appendix A of Appendix 53, Volume 16 makes a prediction of likely recession over the next 50 years difficult.

Even in the absence of sea level rise, some recession would be expected on this coastline because the beaches appear generally to be in a recessional state. A recession of 2 m over the next 50 years might reasonably be expected.

Based on the air photo evidence for the 45 years from 1961 to 2005, coastline recession of the order of 20 to 25 m might be anticipated in this area over the next 50 years. Any such estimate, however, can only be considered to be indicative. The actual rate of recession will be affected by factors such as the occurrence and intensity of storm events, changes in the direction of approach of major storm waves and dispersal of eroded sediments along and offshore.

### ***Risk of pipeline exposure***

The various zones of the beach system present particular risks of exposure of a buried pipeline.

The risk of pipeline exposure in the nearshore zone will be dependent on where in the vertical profile that the pipeline is located. If the pipeline is laid in a trench that is completely within the highly to extremely weathered basalt in the existing nearshore zone it is considered unlikely that it will become exposed over the projected lifetime of the project. However, if the trench is of such a depth that the pipeline is partially or completely in the overlying beach sands it will almost certainly become exposed at various times as the sand is periodically moved offshore. This could have detrimental impacts not only on the pipeline itself but also on beach processes.

The risk of pipeline exposure in the present fore dune area is high because of potential coastal erosion and recession that would lead to the foredunes moving inland, exposing a pipeline that was not buried to a sufficient depth. Potentially, the seaward edge of the foredune could move 25 to 42 m inland from its current position (see above). The zone between the current high water mark and 25 to 42 m inland therefore represents the exposure risk zone. The first 25 m can reasonably be taken to be a higher risk zone and the next 17 m a lower risk zone. Inland of the recession limit, burial rather than exposure is the likely outcome of recession, as the foredunes reposition inland from the new high water mark.

Exposure risk will be considerably reduced, and possibly eliminated, if the pipeline is laid within the underlying weathered basalt. To provide an adequate safety margin in the high risk zone, burial to a depth that provides at least 2 m of cover by weathered basalt in the first 25 m inland from the present high water mark is proposed. From this point inland, the pipeline could be allowed to rise gradually, reflecting the progressively lower exposure risk.

The design proposed by Atteris (2006) has a maximum pipeline gradient of 9% in the first 100 m inland (reaching the existing ground surface approximately 65 m inland from the back of the current beach). At a 9% gradient, in the 17 m between the 25 m and 42 m marks, the pipeline could therefore rise 1.5 m. Fixing a minimum burial (top of pipe) in the weathered basalt of 2 m at the 25 m mark means that there would still be 0.5 m burial (top of pipe) in weathered basalt at the 42 m mark (in addition to any remaining overlying sands) if the worst case of a horizontal basalt layer is assumed. In fact, the basalt layer almost certainly rises inland, meaning the burial depth at the 42 m mark would be greater than 0.5 m.

The above is considered to provide an adequate safety margin against pipeline exposure for the next 50 years.

The risk of pipeline exposure across the existing swale at the back of the foredune is currently considered to be very low. This risk, however, will increase substantially if sea level rise results in the current foredune being completely eroded away and the sand moved offshore.

If the existing foredune migrates inland with a rise in sea level a buried pipeline is likely to stay covered but if the dune is completely removed a pipeline not buried within the underlying weathered basalt may become uncovered.

Sea level rise is considered unlikely to have any significant impact on the old dune area, at least in the projected lifetime of the proposal. Exposure of a pipeline laid within the dune is therefore considered extremely unlikely provided that the trench is properly rehabilitated and revegetated.

With appropriate construction methods, careful rehabilitation and maintenance of vegetation cover, the risk in this area is considered to be very low.

The risk of pipeline exposure as a result of fluvial erosion will be dependent on how close the pipeline is placed to the existing drainage lines and how well vegetation along the drainage lines is maintained. Additional protective measures may be required where the pipeline crosses drainage lines.

With appropriate construction methods, careful rehabilitation and maintenance of vegetation cover, the risk in this area is considered to be very low.

## 9.6 Pipeline Design

### 9.6.1 On-Shore Pipeline Design

Hargrave Pipeline Group Pty Ltd (HPG) report Effluent Pipeline Design Basis Document (2006), provides details of the effluent pipeline design parameters (Appendix 45, Volume 15). The onshore component of the pipeline design will, as a minimum, comply with the requirements of AS 2566 (Buried Flexible Pipelines Installation) and AS 2885 (Pipelines – Gas and Liquid Petroleum), and its referenced standards.

The following documentation for the design and construction will be prepared during detailed design:

- ▶ Pipeline hydraulic calculations;
- ▶ Pipeline water hammer analysis;
- ▶ Meteorological design parameters;
- ▶ Pipeline material specification;
- ▶ Pipeline risk assessment;
- ▶ Pipeline construction specification;
- ▶ Pipeline road crossing calculations; and
- ▶ Pipeline wall thickness calculations.

The parameters of the effluent pipeline are provided in Table 9-5.

**Table 9-5 Effluent Pipeline Parameters**

Pipeline Design Code	AS 2566 and or AS 2885
Seismic Design Code	AS 1170
Class	150
Service Fluid	Treated Effluent
Location Class as per AS 2885	R1 and T1
Design Life	50 years
Design Pressure (MPag)	0.6

Pipeline Design Code	AS 2566 and or AS 2885
Design Temperature (°C)	above ground (max/min): 38°C / -10°C below ground: 0°(min)
Size / Outside / Diameter (mm)	945
Material	HDPE or GRP
Wall Thickness	21 millimetres
Installation	Buried
Minimum Depth of Soil Cover (mm)	750 (Note 1)
Onshore Length (km)	20 (approximately)

Notes: At road and water crossings the soil cover will be increased to minimum 1200 millimetres to account for heavy loads at road crossings and soil cover erosion at water crossings  
Refer to Clause 2.4 Pipeline Materials for more details.

(Source: HPG, 2006)

### 9.6.2 Offshore Pipeline Design

An Ocean Outfall Conceptual Engineering Study (Atteris, 2006) was undertaken for the pulp mill project (Appendix 45, Volume 15). The report forms the basis for the design and construction of the ocean outfall.

**Table 9-6 Offshore Pipeline Design Data**

Pipeline ID (inside diameter)	Approximately 900 mm
Offshore Extremity Depth (Diffuser Section)	20 m (LAT*)
Design Life	50 years

\*Below Lowest Astronomical Tide

Design issues that influence the ultimate design for the effluent pipeline include:

- ▶ shoreline geomorphology;
- ▶ onshore and offshore environmental constraints;
- ▶ route alignment selection;
- ▶ pipeline material selection and mechanical design;
- ▶ outfall diffuser section design;
- ▶ pipeline protection design;
- ▶ pipeline on-bottom stability design;
- ▶ trench and trench backfill design;
- ▶ onshore pipeline design; and
- ▶ construction engineering.

These design issues have been considered as part of the Ocean Outfall Engineering Study and are subject to detailed design. They will be resolved during the preliminary and detailed design engineering phases.

### **9.6.3 Pipeline Stability**

Atteris (2006) (Appendix 52, Volume 16) conducted a preliminary analysis of the pipeline stability. The outfall pipeline must be stable under the hydrodynamic loading conditions that it will experience during its lifetime. For a 50 year design life it is standard practice to perform stability analyses using 100 year return period loading conditions, based on the combination of wave induced and steady state near-bottom current velocities.

The first step is to define this condition. This has been done by using information available from the Bureau of Meteorology supplemented with data from other construction projects that have been undertaken.

For the concept design, the following hydrodynamic loading conditions have been used:

- ▶ Significant wave height  $H_s = 4.9$  m;
- ▶ Wave period  $T_p = 10$  s (assumed);
- ▶ Wave direction from north-west (assumed);
- ▶ Steady state current  $U = 0.2$  m/s (assumed); and
- ▶ Current direction perpendicular to the pipeline (assumed).

The second step is to perform the analyses necessary for the pipeline to be installed with reasonable loads and sufficient on-bottom weight to withstand the design hydrodynamic loading conditions.

Weight and buoyancy control of the pipeline can be achieved by applying additional weight to the pipeline. It will be necessary to apply a reinforced concrete weight coating around the pipeline. This coating provides abrasion protection during installation and operation, and ensures that the pipeline will sink and be stable.

A preliminary analysis indicates that on-bottom stability of a self-weighted concrete coated steel pipeline can be achieved in water depths greater than 15 metres. Inshore of the 15 metre water mark, additional measures would be required to ensure the integrity of the outfall during design storm conditions.

Lateral longshore drift occurs out to depths of 13 to 14 m (Appendix 52, Volume 16) and will require trenching. Then the pipeline will emerge from the trench onto the seabed. This, together with the self-weighting requirements leads to the conclusion that stability inshore of the 15 metre water depth will best be achieved by lowering the pipeline into the seabed, in a pre-dredged trench.

This trench would also provide stability to the pipeline during its installation. The trench length from the back beach out to the 15 metre water depth will be approximately 1,500 metres. In order to maintain the stability of the seabed material areas of unconsolidated sediments will be avoided where practicable.

## **9.7 Diffuser Design**

A multi-port diffuser will be installed at the end of the offshore pipeline to disperse treated effluent. The diffuser will be approximately 200 metres in length and opening at positions 10 o'clock and 2 o'clock at 20 metre intervals. The openings are expected to have a diameter of 15 centimetres. The diffuser will spread the release of the treated effluent, and maximise rapid mixing and dilution.

The final position of the pipeline and diffuser design is subject to detailed site investigation and survey, in the context of minimisation of environmental impact.

## **9.8 Pipeline Materials**

### **9.8.1 Material Options**

Atteris (2006) considered four types of materials used for effluent outfalls:

- ▶ concrete;
- ▶ glass-fibre-reinforced plastic (GRP);
- ▶ polyethylene (PE); and
- ▶ carbon steel.

The material selected for the outfall is based upon a number of factors, including the diameter of the pipeline, construction method and the composition of the product the pipeline will convey.

#### ***Concrete and GRP***

Concrete and GRP pipes are generally only used for outfalls in protected and sheltered environments, where the pipes can be placed one-by-one and joined together mechanically inside a pre-dredged trench using a crane barge with diver support. GRP is generally preferred over concrete pipes for long outfalls because GRP is a lighter material and easier to handle than concrete, while still being sufficiently dense to sink when submerged. The light weight of GRP makes it cheaper to transport to site. Furthermore, as GRP is installed pipe-by-pipe offshore, an onshore stringing area is not required to prefabricate the pipeline.

Unlike steel pipelines, GRP is not subject to corrosion and therefore corrosion protection is not required.

The downsides of using concrete or GRP are:

- ▶ the need to pre-dredge the entire length offshore;
- ▶ the potential limited workability in relation with ambient seastate conditions; and
- ▶ in particular for the GRP material, the need to backfill the entire length of the trench with engineered backfill to stabilise the pipeline.

#### ***Polyethylene (PE)***

PE is normally used for smaller diameter outfalls of limited length (typically up to 500 - 600 millimetres in diameter and several hundred metres in length) in sheltered areas where the pipeline string can be

floated out and placed onto the seabed by filling it with water and placing weights (gravity anchors) onto the pipeline at discrete intervals. For the pulp mill effluent outfall, PE will be impractical due to its large diameter and extensive length for this material:

- ▶ the typical wall thickness for a 900 mm diameter PE pipe is 50 – 60 mm which is difficult to butt weld, in particular the tie-in welds;
- ▶ the limited tensile strength of PE compared to carbon steel will impose a risk during launching of the pipeline string(s);
- ▶ considering the hostile ambient sea conditions, there is a very high risk of damaging the string or failing to install it due to its light weight; a PE pipestring would have to be floated out and sunk to the seabed by filling it with water and placing gravity anchors onto it. It is a certainty that this operation, which will take several weeks, would encounter sea conditions which may damage the pipeline string; and
- ▶ in view of the limited submerged weight of the pipeline, the stabilisation required would be excessive.

### ***Carbon Steel***

Carbon steel is a commonly used material for long sea and ocean outfalls. Steel pipe has the benefit of being a high density and robust material. It is standard industry practice to apply a reinforced concrete weight coating to the outside of the pipeline to ensure that it sinks during installation and to assist in long term stabilisation of the pipeline on the seafloor.

The robustness of steel in combination with a continuous concrete coating also provides a level of protection against any mishaps that may occur during installation and does not necessarily require burial after installation for protection. Steel is also flexible over long lengths.

A downside of using carbon steel is that the material is subject to corrosion. However, carbon steel is used extensively for onshore and offshore pipelines and the methods of protecting offshore pipelines from corrosion are highly evolved. Section 9.8 discusses the different commonly used method of protecting offshore pipelines from corrosion.

Photograph 9-1 an example of concrete coated steel pipe similar to that proposed for the offshore pipeline.



**Photograph 9-1 Concrete Coated Steel Pipeline Strings for Long Sea Outfall**

### **9.8.2 Corrosion Protection**

A corrosion protection coating is required when using steel pipe. External corrosion coating can take the form of asphalt enamel or a similar product, which in turn is protected by the reinforced concrete that is applied on top of it. The requirement for an internal coating will depend on the effluent parameters. This can either be an epoxy coating or a cement lining (Atteris, 2006).

A secondary form of protection against corrosion of the pipeline is cathodic protection. This is usually installed at the interface between the offshore pipeline and the onshore pipeline (ground anode bed). Additionally or optionally, aluminium or zinc bracelet anodes can be installed around the pipeline at several tens of metres intervals, flush with the concrete weight coating surface.

The method of corrosion protection will be determined during the detailed design phase.

### **9.8.3 External Impact Protection**

Additional protection against external impacts can be achieved by either burying the pipeline into the seabed along its entire length, or by providing a protective cover on top of the pipeline using quarried rock (Atteris, 2006). This is discussed in more detail in Appendix 52, Volume 16.

### **9.8.4 Recommended materials**

Based on the preliminary investigation, GRP is proposed for the onshore pipeline within the laydown area. GRP is durable and robust material that is not susceptible to corrosion (Atteris, 2006).

The material for the outfall will be either GRP or carbon steel with a reinforced concrete weight coating subject to geotechnical investigation and detailed design. Internal and external corrosion coatings are at this stage assumed to be epoxy and asphalt enamel respectively.

#### **9.8.5 Summary**

The onshore pipeline materials will comply with the requirements of AS 3571 (Glass filament reinforced thermosetting plastics (GRP) pipes - Polyester based - Water supply, sewerage and drainage applications) (HPG, 2006). The onshore pipeline will be 924 mm outside diameter and likely to be constructed of glass fibre reinforced thermosetting plastic with a wall thickness of 21 mm.

The wall thickness and each grade will satisfy pressure containment, external load, full vacuum loads, water hammer loads and risk assessment requirements.

### **9.9 Construction of the Pipeline**

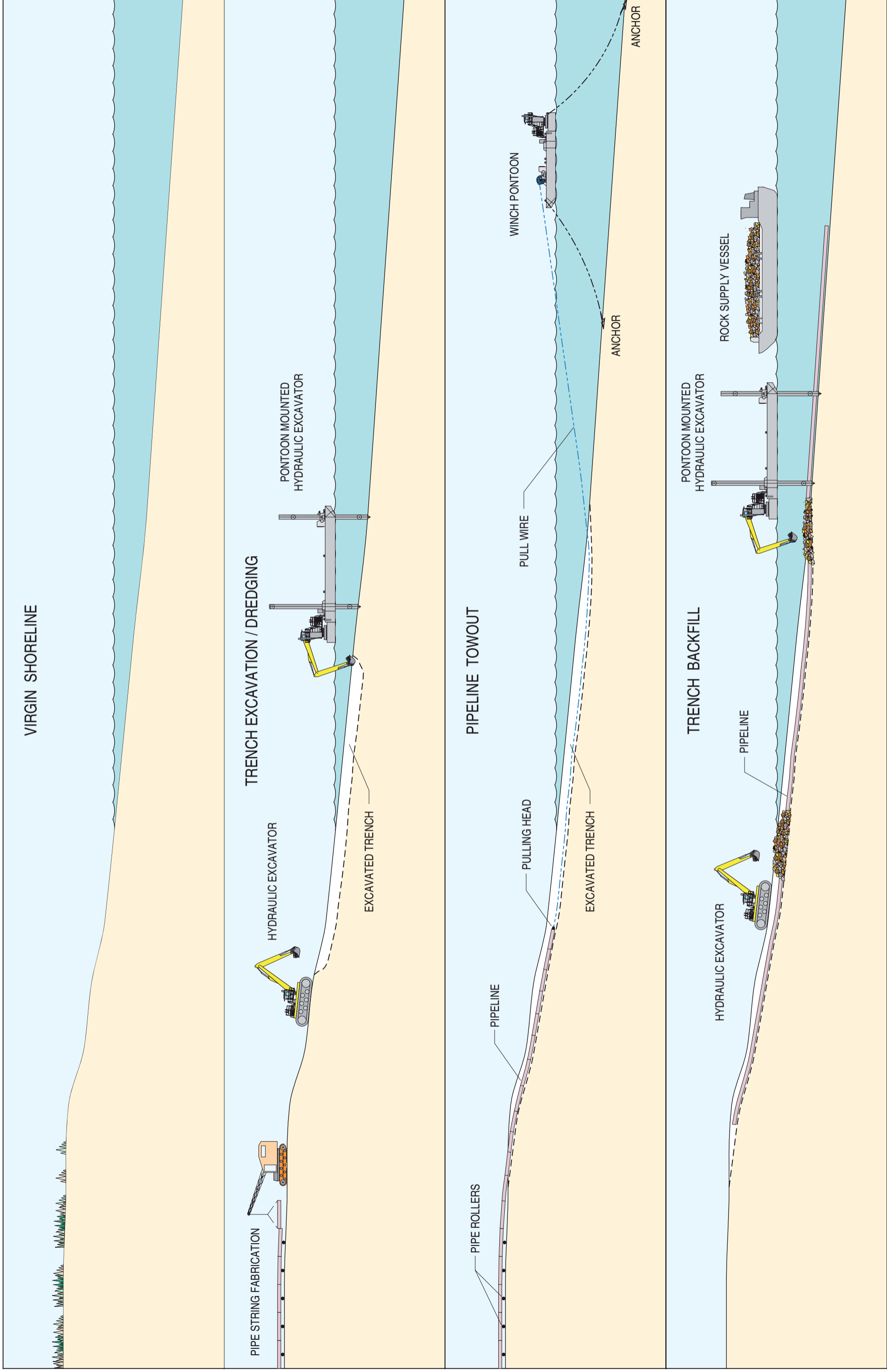
#### **9.9.1 Overview**

An open cut trenching method will be used for the construction and burial of the majority of the effluent pipeline. Trenches will be dug to a width of 2 m and a depth of up to 3 m. The onshore crossing of a dune (approximately 60 m long with a maximum depth of 30 m) which has been identified as contained an EPBC Act listed species (*Xanthorrhoea aff. bracteata*), in the vicinity of the ocean outfall, will be undertaken by pipe jacking or auger boring. This methodology has been determined to avoid disturbance to this species. The construction concept of the ocean outfall section has been developed based on open-cut trenching, followed by towing-out prefabricated weight-coated steel pipeline string sections. Preliminary analyses indicate that the first 1.5 km from shore will be pre-trenched (Figure 9-1).

#### **9.9.2 Laydown Areas**

Laydown areas are designated areas that will allow temporary storage of materials and preparation of works to occur. There will be two main laydown areas for the effluent pipeline: the Bell Bay Port and an area at Four Mile Beach near the ocean outfall.

Pipe lengths up to 12 metres will be transported to the Bell Bay Port by ships. The pipeline sections will be stockpiled at the Port and be trucked to various locations along the pipeline route.



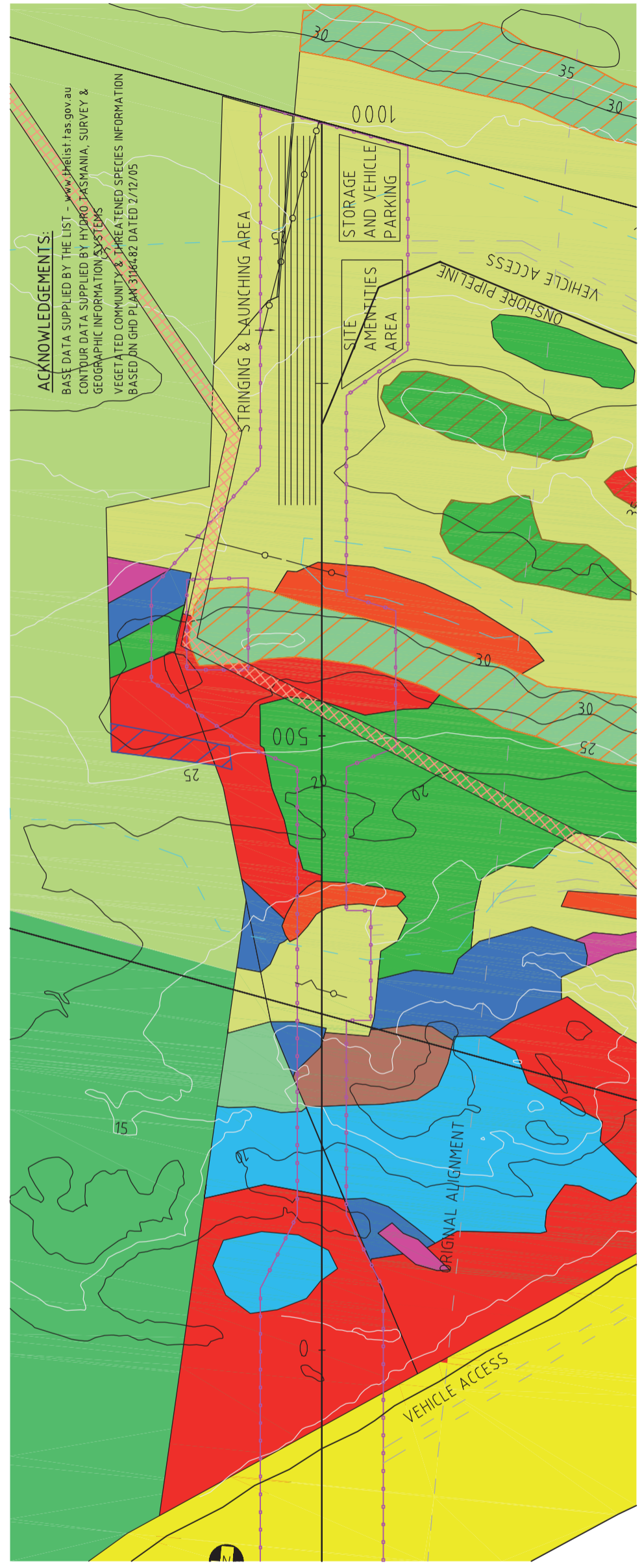
TYPICAL PIPELINE SHORE CROSSING CONSTRUCTION  
(OPEN CUT)

Figure 9-1

- BRACKEN FERN (FPF)
- GRASSLAND (GSL)
- COASTAL SCRUB (SAC)
- MARRAIT GRASSLAND (FMG)
- MELALEUCA ERICIFOLIA (NME)
- AGRICULTURAL (FAG)
- SEDGY HEATHLAND (SHL)
- F/W AQUATIC SEDGELAND & RUSHLAND (ASF)
- LACUSTRINE HERBLAND (AHL)
- WET HEATHLAND (SHW)
- RE-GENERATING CLEARED LAND (FRG)
- ACACIA ULICIFOLIA
- XANTHORRHOEA ARENARIA & BACTEATA
- XANTHORRHOEA ARENARIA & BACTEATA, ACACIA ULICIFOLIA
- CROWN LAND (UNSURVEYED)
- PRIVATE LAND (UNSURVEYED)
- SEDIMENT

- CONTOUR (MAJOR)
- CONTOUR (MINOR)
- WATERWAY
- BASSLINK EASEMENT
- EXCAVATION
- SITE BOUNDARY
- EXISTING FENCELINE
- PIPELINE STRING

**PLAN**  
1:4,000



APPROX 50 - 60 m  
AUGER BORE

STRINGING AREA  
300 M



DATUM R.L. -14.00

	0	100	200	300	400	500	600	700	800	900	1000
NATURAL SURFACE		9.601	14.104	16.57	18.305	23.069	26.732	27.326	27.326	27.326	25.016
PIPELINE	6.818	9.265	14.104	14.104	18.305	23.069	29.399	27.326	27.326	27.326	25.016
CHAINAGE	7	9.601	15.164	16.57	18.122	25.93	29.399	28.287	25.782	24.817	

**LONGITUDINAL SECTION**  
HORIZONTAL SCALE 1:4,000  
VERTICAL SCALE 1:2,000



DRAWING No	REFERENCE DRAWINGS	REV No	DATE	REVISION DESCRIPTION
		2	17/12/05	UPDATED EYCS AND THREATENED SPECIES
		1	18/10/05	UPDATED WITH FURTHER INFORMATION
		0	22/9/05	ISSUED FOR APPROVAL



DRAWN: CAMPBELL DATE: 22/09/05		CHECKED: E.JAS DATE: 22/09/05		APPROVED: E.JAS DATE: 22/09/05		CLIENT: AS SHOWN		SCALE: 1:3		DWG No 05-003-D-002		REV. 2-P	
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BELL BAY PULP MILL  
OCEAN OUTFALL STRINGING  
AND LAUNCHING ALIGNMENT

A second dedicated laydown area is located near the ocean outfall and will temporarily store construction materials, pipe lengths and other pipeline components, construction machinery and vehicles. The laydown area is approximately 20ha and has been strategically located to minimise disturbance to the dunes and terrestrial ecology (Figure 9-2).

### **9.9.3 Onshore Construction**

#### ***Open-cut trenching***

The majority (approximately 18 km) of the effluent pipeline construction corridor will be 20 m wide and the pipeline trench will be dug to a width of 2 m at the bottom of the trench and a depth of up to 3 m. The construction method will require trench excavation, pipeline installation, backfilling, rehabilitation, and pipeline marking.

The pipe will be laid backfilled and rehabilitated in accordance with management measures outlined in the environmental management plans outlined in Volume 4.

The pipeline route will be marked to meet Australian Standard 2556.

#### ***Pipe-jacking***

To avoid impact on a sand dune supporting *Xanthorrhoea aff. bracteata* a listed species under the EPBC Act, (refer to Section 10.13), pipe jacking or auger boring will be used to construct the pipeline under this dune, a distance of approximately 60 m (Figure 9-2).

Pipe jacking involves hydraulically pushing pipes from a constructed drive shaft. There are various types of equipment that fall under the pipe-jacking category, including micro-tunnelling and auger boring.

Micro-tunnelling is a steerable form of pipe jacking and is utilised for long length crossings of varying diameters up to approximately 3 m. Auger boring is generally a non-steerable form of pipe jacking (although some auger bore techniques have limited steering capabilities) and is utilised for shorter length crossings of varying diameters up to 1.8 metres. During pipe jacking the spoils are removed back to the drive pit by helically wound auger flights rotating in the jacked pipe.

Although auger boring is noticeably more economic than micro-tunnelling, it has the following downsides:

- ▶ the inability to correct any misalignment during jacking limits the applicable crossing length to approximately 50-60 m; the pipeline will naturally move to the material of least resistance; and
- ▶ given that the face is open, there is a risk of subsidence when boring in sand.

The form of pipe-jacking, auger boring or micro-tunnelling will be decided during detailed design.

#### ***Shore Crossing***

The pipeline will be buried to a minimum depth of 750 mm of cover. The pipe will have an internal diameter of 900 mm and, subject to the external wall thickness, an external diameter of approximately 1.2 m.

The pipeline installation will involve a combination of open trenching and auger tunnelling.

A pipeline stringing and launching area will be established on agricultural pasture inland from the dune system. In this area, sections of pipe 200 to 250 m long will be stored before being sequentially welded together as the pipeline is progressively pulled out to sea.

To facilitate the pull out, high areas on the pipeline alignment will be excavated and low areas will be traversed with temporary tower supports. The stringing excavations will be used as part of the final trench for the pipeline burial, and the tower supports will be removed when the pipeline is lowered into its trench.

The pipeline will approach the stringing and launching area from the mill side in an excavated trench, which will be 2 m wide at its base. The pipeline will leave the stringing and launching area towards the dune system in a similar excavated trench for a short distance prior to entering a 1.5 to 1.8 m diameter bored tunnel underneath the section of the hind dunes that is dominated by *Xanthorrhoea arenaria* and *X. bracteata*. The depth of this tunnel will need to be sufficient to avoid damage to the root systems of the *Xanthorrhoea arenaria/ bracteata* and alteration to the local drainage patterns. Tunnelling will avoid impact on this sensitive vegetation. The tunnel through this dune will be approximately 60 m long.

Tunnel creation would be by auger boring and pipe jacking, whereby specially made casing pipes are hydraulically pushed through the sand from one side of the dune to the other. Entry and exit pits would need to be dug at each end. Spoil is removed from the casing pipe, allowing the effluent pipeline to be laid inside it.

On the seaward side of the hind dune, the pipeline will again be laid in an excavated trench that runs through bracken fern, coastal heathland and grassland. There is also a small area of *Melaleuca ericifolia* that will be impacted.

The pipeline will need to maintain a relatively constant grade as it passes under the dune system, meaning that it will lie at varying depths below the ground surface depending on the relative height of the dunes. In the conceptual design, the pipeline depths (depth of base of trench/tunnel) below ground surface vary between 1.9 m and 4.7 m. Due to the possibility of coastal retreat due to climate change (Appendix 52, Volume 16), the pipeline will need to be trenched from the back of the beach inland to the 25 m mark with the top of the pipe at least 2 m below the surface horizon of the weathered basalt underlying the sand dunes and then it will be allowed to rise to no closer than 0.5 m below that horizon by the 42 m mark. At the toe of the foredunes, the pipe will therefore have at least 2 m of cover.

Different trenching methods will be used for different trench depths and different situations.

The simplest form of trenching is an open trench with walls laid back on a 1 in 2 batter for 4 m either side of the trench. This form of trenching is only practical for trench depths less than 2 m. The total trench width would be 10 m. The excavator would work along one side of the trench and excavated material would be temporarily stored alongside the trench prior to backfilling. This working and storage area would typically be 7 to 10 m wide. The total width of disturbance would therefore be up to 20 to 25 m wide.

An alternative form of trenching is a trench with vertically shored sides. This form of trenching is suited to deeper trenches (1.0 to 3.5 m deep) in tighter or more sensitive areas. The excavator would work

along one side of the trench and store excavated material in stockpiles on the other side. The total width of disturbed area would be up to approximately 15 to 20 m wide.

For trench depths greater than 4 m, a second level of shoring could be used to achieve the extra depth while not increasing the width of the disturbed area. Alternatively, in less sensitive areas, trenching deeper than 4 m could be achieved by the excavator first benching in to 1 m deep with a sloping side trench and then digging a shored trench for the remainder of the depth. The total width of the disturbed area would be approximately 20 to 25 m.

The total area of disturbance for the dune crossing will be determined by a combination of the trenching methodology, the need for temporary stockpiles of excavated material prior to backfilling and the requirements for a pipe stringing and launching area, with amenities and vehicular parking. A site boundary will be delineated to control the maximum extent of disturbance (Figure 9-2).

#### **9.9.4 Offshore - Donovans Bay**

The pipeline crosses Donovan's Bay between kilometre points (KP) 2.1 to 2.4 (approximately 300 metres in length), just north of the Bell Bay Power Station (Figure 9-3). It will be located to the east of the existing Tasmanian Natural Gas Pipeline.

HPG has prepared a *Donovan's Bay Construction Management Plan* (February 2006) for the crossing (Appendix 54, Volume 16).

The effluent pipeline will be buried in a trench within the tidal zone of Donovans Bay.

Construction preliminaries will involve route survey, clearing of approaches, construction of a rubble access road on geo-fabric on the western side of the trench, and a low sandbag dam constructed using bulk fill bags further to the west.

##### ***Trench Excavation***

Excavation of the trench will commence from both sides of Donovan's Bay, shortening the period exposed to construction. Hydraulic excavators will be used and will excavate the trench from the side utilising the temporary road.

The use of hydraulic excavators will assist in the removal of sediment in amalgamated clumps where practical, minimising the suspension of sedimentary material.

Where rock is encountered hydraulic rock breakers or rippers will be utilised.

Blasting is not proposed at this stage due to the existing Tasmanian Natural Gas Pipeline that runs parallel with the proposed effluent pipeline. However, if some minor blasting is required to fracture the exposed rock, a qualified contractor will prepare a blasting plan for approval by appropriate authorities.

Excavated material (trench spoil) will be stored between the temporary road and the temporary sand bag wall.

### ***Pipe Preparation***

The pipe will be strung and joined to form a continual pipeline string. The string will be on either the north or south side of the bay and it will be pre-hydrostatic tested.

Should buoyancy calculations show that bolt on concrete weights are required to reduce the risk of flotation during operation of the pipeline, they will be installed as per an approved method statement.

Prior to lowering-in the string may be placed on roller bed and flotation devices attached should calculations prove that they are required. These calculations will be preformed during detailed design.

**Figure 9-3 Donovans Bay Crossing**

### **Lowering in**

The pipe string will be towed from the opposite side of the bay from which the string is located during the high tide period.

It is proposed to float the string out into the bay so that it is correctly aligned. Pre-installed stakes will assist in positioning the string. Any flotation devices used will be removed and the string sunk into the open trench.

Surveyors will ensure accurate location, alignment and adequate cover as per the alignment sheets and specific drawing once the string is in position.

### **Backfill**

Soft materials excavated during trenching is preferred for backfill material. Should this not be suitable, imported clean sand may be required.

Excavators will commence backfill in the middle of the crossing, working back to the shorelines on both sides.

It is expected that disturbance and sedimentation will occur during backfill of the low area of the bay. Backfilling will occur for this section only during the first two-thirds of the outgoing tide.

### **Reinstatement**

Any excessively turbid waters that have built up behind the walls will be pumped to shore and filtered. Silt filters will consist of clean straw bales lined with geotextile fabric. Filtered water will be released in a controlled manner back into the bay.

The temporary dam wall and stockpile area will be reinstated. The sand bags and any left over excavated material will be removed by excavator to the shoreline and disposed of at licensed landfill site. Works will be carried out on the first two-thirds of the outgoing tide.

The temporary road will be dismantled from the centre working back to both shorelines. Some of this material can be utilised as rip rap over the trench line. Excess material will be removed to the shoreline and disposed of at an appropriately licensed landfill site.

The site will be reinstated, as close as possible to the preconstruction profile, minimising the creation of raised areas likely to aid the spread and colonisation of *spartina* (rice grass).

Works will be carried out at low tide or when the site is exposed.

## **9.9.5 Offshore Four Mile Beach**

### **Construction method**

Construction of the offshore pipeline will utilise a stringing and launching corridor. A construction concept has been developed based on temporary trestles, open-cut trenching and auger boring, followed by bottom-towing prefabricated weight-coated steel pipeline string sections. Preliminary analysis supports the first 1.5 km from shore being pre-trenched. Should the option of GRP pipeline be

adopted it will be required to be trenched and backfilled for its entire length. The concept will be subject to detailed design.

### ***Seabed preparation***

Seabed preparation for a concrete coated steel pipeline includes the excavation and dredging of the trench out to the 15 m water depth. From 15 m depth out to 26 metres depth, bottom preparation or smoothing of the seabed is necessary to ensure that the pipeline can be installed safely, and to ensure that the pipeline will not be subject to excessive freespans caused by seabed irregularities. For a GRP pipeline a trench would need to be dredged along the entire alignment.

Trench design defines trench depth, bottom width and side slope angle. These are a function of excavation/dredging equipment capable of operating in the site conditions, the geotechnical parameters, pipeline installation method, and pipeline stability requirements (in the case of no trench backfill). At this stage, it is estimated that trench depth will be 2 to 3 m and the trench bottom will be about 3 to 5 m wide. It is expected that trench side slope angles will be between near vertical and 45 degrees. Total estimated trench volume will be approximately 50,000 m<sup>3</sup> for a steel pipeline (or approximately 100,000 m<sup>3</sup> for a GRP pipeline).

Prior to the dredging of the trench, locations will be identified where spoil may be located temporarily prior to backfilling. Areas of low relief reef and sediment are the preferred area for the location of spoil, and will minimise the environmental impact. Large areas of low relief and sediment have been identified in the vicinity of the proposed trench and these are suitable for the temporary storage of spoil material. The dredged material will be used to backfill the trench.

The width of the seabed potentially affected during the construction of the outfall is expected to be up to 50 m.

Depending on the trench bottom roughness it may be necessary to install a bedding layer across the trench bottom to protect the pipeline during installation. This can be achieved with a 0.3 m thick gravel or crushed rock layer placed in the trench after dredging of the trench has been completed.

### ***Open Cut Trenching***

The installation of a weight-coated steel pipe involves the following main activities:

- ▶ pre-fabrication of pipeline string(s) onshore;
- ▶ excavation of trench onshore and across the beach to the low water mark using onshore based excavation equipment;
- ▶ dredging of trench / seabed preparation offshore using dredging equipment;
- ▶ launching of pipeline string(s) using winch-pontoon or similar; and
- ▶ trench backfill / onshore site restoration.

Trenching is normally performed using shallow water dredging equipment, such as a cutter-suction dredge, or a clamshell or backhoe dredge. In this particular case, backhoe dredging will be the most suitable method for the following reasons:

- ▶ A backhoe dredge is capable of dredging weak and weathered rock, and can readily be fitted with a subsea rock breaker if stronger rock pockets are encountered.
- ▶ The turbidity in the water column from the dredging operations is generally more limited compared with other dredging methods. Backhoe dredging is a mechanical form of dredging whereas a cutter-suction dredge dredges material hydraulically with a much greater turbidity (it mixes the material with water when sucking/pumping the material).
- ▶ A backhoe dredge has the ability to accurately create a relatively narrow trench.
- ▶ A backhoe dredge is an effective tool to assist with trench backfill.



**Photograph 9-2 Back Hoe Dredge**

### ***Pipestring Launching Concept***

Long ocean outfalls constructed with weight-coated steel pipe are usually launched into position from an onshore launchway (roller track) using the bottom-tow method, whereby the pipeline is dragged along the trench bottom and/or seabed with a specifically designed submerged weight.



**Photograph 9-3 Typical Overview of Pipe String Launching Operation (Several Strings)**

Launching the pipeline string in floating mode is not proposed due to the following considerable risks:

- ▶ risk of string drifting laterally from the alignment under the wave, wind and current loading; and
- ▶ risk of overstressing the pipe material (this will crack the concrete coating) and buckling the pipeline when filling with water to sink the pipeline into the trench or onto the seabed during the installation process.

### ***Pipestringing***

The outfall pipeline string will be pre-fabricated in several shorter lengths of 200-250 metre sections in view of the onshore environmental constraints (the requirement to avoid *Xanthorrhoea aff. bracteata* and an Aboriginal Archaeology Site) and the onshore topography. Some excavation will be required through the onshore alignment to reduce the elevations traversed by the pipe string. Low terrain areas can be overcome by constructing temporary steel towers or trestles, as shown on the pictures following.

Where excavation is necessary, material will be stockpiled in designated areas clear of identified sensitive vegetation communities.

Excavations for the stringing alignment will also be used as part of the trench for the onshore pipeline installation.



**Photograph 9-4 Proposed Stringing Site**



**Photograph 9-5 Temporary Tower Supports for 26" Pipe String Launching**

### ***Trench Backfill***

Trench backfill is required:

- ▶ if there is an unacceptable risk that the pipeline will be lifted out of the trench during storm conditions; and/or
- ▶ if an open trench forms a safety hazard to the public or protected fauna and/or to protect the pipeline from damage by the public (e.g. across the beach).

Trench backfill can be achieved using dredged and excavated material. Additionally, engineered fill may be required, in which case a local source (rock quarry) will need to be utilised. The latter may be

necessary to avoid liquefaction of sand/silt under wave loading, which may cause the pipeline to float up.

The future operation requirements of the pipeline and outfall will be considered during preliminary design to ensure that inspection and maintenance facilities are installed in appropriate locations and in accordance with the specified inspection, maintenance and repair philosophy (Atteris, 2006).

#### **9.9.6 Construction period**

The construction duration is anticipated to be in the order of 6 to 8 months for the pipeline including the off-shore ocean outfall.

During this time, the easement of 20 m will enable right of way for construction machinery such as excavation equipment, trenchers and pipelayer equipment to access and install the pipeline. Standard vehicles and authorised personnel will also be moving about along the pipeline easement.

A preliminary time schedule presenting all the design and construction activities is provided in Attachment 5 of Appendix 52, Volume 16 (Atteris, 2006).