Expert witness statement of Mr Eric Pieter Jas Expert of Gunns Limited

In the matter of the Bell Bay Pulp Mill Project: A project of State Significance Resource Planning and Development – Commission Inquiry

Proponent: Gunns Limited

1 Name and address

Eric Pieter Jas

Atteris Pty Ltd

Level 6, 68 St Georges Terrace

Perth, WA 6000

2 Area of expertise

My areas of expertise are the design and construction of pipelines, pipeline shore crossings, horizontal directional drilling (HDD), pipe jacking and dredging.

My qualifications and experience are detailed in Attachment 1.

I am sufficiently expert to make this statement because I have performed and managed the feasibility design, detailed design and been involved with the construction of numerous pipeline shore crossing within Australia and internationally.

I have experience in the design of ocean outfalls for effluent pipelines and pipeline shore crossing for oil and gas developments.

I have been responsible for the design of a number of difficult pipeline shore crossings (landfalls and outfalls) in Europe, South East Asia, Australia and Northern America using conventional open cut and cover methods, and HDD.

I am the Managing Director of Atteris Pty Ltd, a specialised engineering company in this field.

Atteris is a Perth based engineering company that specialises in the engineering design and construction management of pipeline shore crossing and offshore pipelines. Atteris has been the recipient of the Engineers Australia Excellence Award 2005 for its work on the Trunkline System Expansion Project (TSEP) on behalf of Woodside Energy Ltd. Atteris was responsible for the design and construction of the shore crossing for this project.

Atteris has also been awarded the WA Engineers Australia Excellence Award 2006 for its work with Woodside Energy Ltd on the Otway Gas Project. This project involves a 750 mm diameter pipeline constructed across the shoreline within Port Campbell National Park on the south-west coast of Victoria using micro-tunnelling in combination with horizontal directional drilling technology.

3 Scope

3.1 Instructions

Gunns engaged Atteris to perform a conceptual engineering study for the treated effluent outfall on the basis of the following scope:

- Review available site data and idenfity which additional data needs to be acquired to allow the design of the outfall to be undertaken.
- Review, discuss and screen outfall construction methods, and subsequently recommend and develop a technically feasible and cost-effective construction concept.
- Develop a conceptual design for the marine section of the outfall pipeline and dune crossing section immediately onshore, and highlight design issues that require consideration during the preliminary and detailed design phases.
- Assess the construction period and environmental impacts.

Atteris are the author of the report titled Ocean Outfall Conceptual Engineering Study which is enclosed under Volume 16 of the IIS Report. I adopt the contents of this report. This evidence provides a summary of the IIS Report with particular emphasis on my recommended construction method and my discussion of alternatives and the reasons why these alternatives are not recommended.

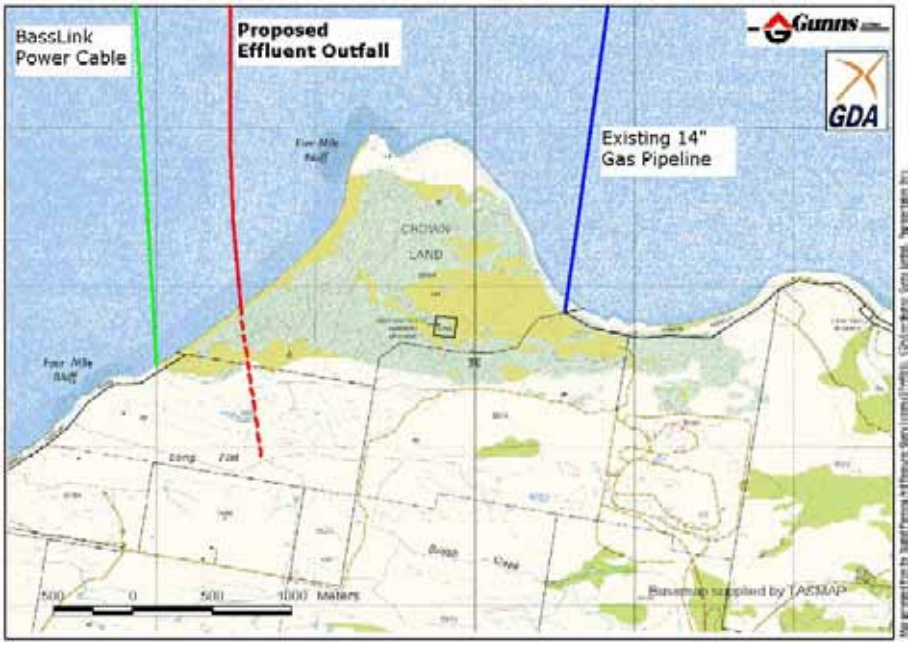


Figure 3.1

Site Overview

3.2 Process and methodology

In this project I have:

- Managed a desktop study of information sourced publicly and provided by Gunns in relation to the ocean outfall. I have inspected the proposed outfall site and adjacent area, and took part in the consideration of alternative shore crossing locations between Four Mile Bluff and Five Mile Bluff.
- With my Lead Engineer, Dean Campbell I have assessed the suitability of alternative construction methods based on the information at hand and made recommendations with regard to site investigations to further define the site conditions.
- Managed the design of the effluent outfall and the corresponding onshore stringing area on the basis of the geotechnical coring, engineering geology, geomorphology, and environmental constraints (vegetated communities).
- Recommended a preferred construction method.
- Managed the design optimisation to minimise disturbance to sensitive dune vegetation.
- Managed the design and optimisation of an ocean outfall alignment based on survey information.
- Provided input to, and supervised the preparation of the Ocean Outfall Conceptual Engineering Report.
- I have taken part in meetings with DPIWE to address comments and concerns regarding the recommended construction methodology.
- I have also reviewed the location of the diffuser and agree that the current location provides a benificial outcome for the construction of the outfall.

3.3 Reports reviewed

I have considered or reviewed the following reports and materials:

1. Geological Assessment – Shoreline Crossing, Pitt & Sherry, Doc No. H05164H001 Rev A, June 2005. – Volume 16, Appendix 53.
2. Tasmania Natural Gas Project, Development Proposal and Development Management Plan, Duke Energy International, April 2001.
3. Basslink - Tasmanian Nearshore Survey (Marine), AMOG Consulting, February 2001
4. Wave Climate, General Oceanography & Geomorphology (Marine), AMOG Consulting February 2001.
5. Modelling effluent dispersion in Australian Coastal Waters, C. B. Fandry, S. J. Walker and J.R. Andrewartha, CSIRO, March 1996
6. Duke Energy Pipeline, Borehole Log for Tasmania Shore Crossing - Onshore Borehole, Worley, 30-Oct-2000
7. Environmental Impact Assessment - Siting and design of submarine outfalls, Russell G. Ludwig, 1998.
8. Geomorphological Assessment – Proposed Shoreline Crossing Area – Effluent Pipeline, Pitt & Sherry; 2005. – Volume 16, Appendix 51.
9. Draft Ecological Vegetation Communities and Quadrat Sampling Locations, Effluent Outfall Pipeline Area, GHD Drawing No. 3116482 dated 2/12/05
10. Gunns Ltd Pulp Mill, Marine Biological and Pollutant Survey at the Proposed Outfall Site, Aquenal, 2005.
11. Draft Location of threatened species, Effluent Pipeline Outfall area, GHD Drawing number No. 31116482 dated 04/10/05.
12. Proposed Pipeline, Four Mile Bluff, Georgetown; Onshore Geotechnical Investigation, BFP Consultants. November 2005 – Volume 18, Appendix 51.
13. Gunns Ltd, Bell Bay Pulp Mill, Draft Integrated Impact Statement, July, 2006.
14. Gunns Ltd, Report for Gunns Pulp Mill EIS, Metocean Report, May 2006

3.4 Assumptions

There were no assumptions made during the study period. I have relied to the information set out in Section 3.3.

3.5 Limitations and exclusions

- The location of the ocean outfall between Four Mile Bluff and Five Mile Bluff was identified prior to Atteris being engaged to provide conceptual engineering. I have inspected the proposed outfall site and adjacent area, and took part in the consideration of alternative shore crossing locations between Four Mile Bluff and Five Mile Bluff.
- A geotechnical survey of the outfall site has only been performed along the onshore section of the outfall alignment. It should be recognised that an offshore geotechnical survey will be required as part of the detailed design of the outfall.

4 Findings

4.1 Conclusions and Recommendations

The offshore alignment has been selected to construct the 900 mm internal diameter pipeline within sediment and low relief reef areas, minimising the disturbance of high and medium relief reef areas.

The onshore construction footprint has been refined with the objective to minimise the onshore environmental impact. To achieve this it is proposed that the onshore pipeline route utilises the stringing and launching corridor of the marine pipeline.

A conventional construction concept has been developed based on temporary trestles, open-cut trenching and auger boring, followed by towing out pre-fabricated weight coated steel pipeline string sections as illustrated in Attachment 5. A preliminary stability analysis based on the metocean conditions (GHD Metocean Report – May 2006) indicates that the entire outfall will need to be pre-trenched. The trench will require backfilling after the pipeline installation.

There is a possibility that all rock (including the outcropping rock) can be dredged directly using a (large) backhoe dredge, as long as it is sufficiently weathered and/or fractured. However, lack of geotechnical coring data precludes drawing conclusions regarding this matter. A form of rock fragmentation, either by subsea rock hammering or drilling & blasting may be required.

If direct dredging is not possible, and rock needs to be fragmented on a large scale, then a partly un-trenched solution may need to be considered based on the outfall pipeline being anchored to the seafloor using rock anchors or by a rubble mound cover using quarry rock offshore of the 10 m water depth contour. I recommend that inshore of the 10 m water depth contour the outfall pipeline be buried below the beach and seabed in view of otherwise disturbing the littoral drift.

Horizontal Directional Drilling (HDD) is not considered technically feasible in view of the poor geotechnical conditions for this method in combination with the length and diameter of the outfall pipeline.

The optimum location of the outfall diffuser section is presented on the alignment drawing in Attachment 2. I recommend that the diffuser section be located in an area where the seabed is stable, in this case where the seabed comprises rock. The proposed site of the diffuser provides a stable foundation. This location also provides an optimal alignment which is straight for ease of construction. The alignment is closer to the prevailing wave direction which reduces the hydrodynamic impacts of the outfall.

Short term impacts

General

An assessment of the environmental features and impacts is made in the IIS Report. This section highlights some of the issues that require focus during the construction of the offshore and onshore pipelines.

Onshore

Native vegetation will need to be removed exposing the ground to erosion from wind and precipitation, also causing dust during dry periods. Erosion can be avoided during works by constructing temporary drainage and silt traps during site preparation combined with the use of geofabrics. Dust can be suppressed by water spraying during dry weather.

Imported hard stand material is likely to be required, which has the risk of introducing foreign species or diseases such as Phytophthora to the site. Testing the source of hard stand material and the site prior to construction is a common way to eliminate this risk. It is also recommended to implement procedures to ensure that construction equipment, in particular tracked machinery, is cleaned prior to accessing the site.

The use of construction equipment poses the risk of spilling hydrocarbons. Adequate environmental management plans and procedures will need to be prepared and implemented to manage this risk.

Growth of native vegetation should be promoted immediately upon completion of construction to avoid long term erosion.

The short-term impact of open-cut trenching will be higher when compared to HDD. However, in the long term, with the development and implementation of a sound environmental management plan, the difference in impact will be negligible in the sense that the visibility of the backfilled trench alignment will disappear over time.

The onshore stringing alignment crosses through an area that has been identified as a region containing Xanthorrhoea aff. bracteata (EPBC listed) and Acacia ericifolia which are both considered rare in Tasmania (Ref 11).

The use of the pipeline stringing and launching alignment for the onshore pipeline route corridor minimises the disturbance of the dunes through the area. The pipeline corridor has been optimised through the design process to ensure that level of disturbance to the identified sensitive flora species and an aboriginal heritage site have been minimised. The adoption of a pipe jacked dune crossing will mitigate disturbance of the Xanthorrhoea aff. bracteate. The pipe jacked tunnel will pass 6 m under the dune. Attachment 3 shows the layout of the proposed tunnel under the dunes.

Offshore

Dredging and/or blasting causes turbidity in the water column due to the release of small sediment or rock particles. Use of mechanical dredging equipment such as a pontoon-mounted hydraulic excavator (backhoe dredge), will have a significant benefit in this regard compared to hydraulic dredging methods such as cutter suction dredging. The fact that tidal currents are very low at the site has a positive effect in that any turbidity will be limited to the immediate area of the dredging location.

The use of silt screens is not recommended in open water conditions given that they are only effective in very sheltered areas such as ports and harbours.

Use of explosives underwater is perceived by many to have major detrimental effects on marine life. This was very much the case in the early days of subsea drilling & blasting. However, these days controlled blasting methods exist which significantly reduce impact onto marine life. Use of controlled drilling & blasting has recently been used in environmentally sensitive areas with great success. During the construction of the Second Gas Trunkline near Dampier, WA for Woodside Energy, explosives were used extensively within a marine national park (Mermaid Sound) with minimal impact to the local environment, which is habitat to marine mammals and sea turtles. Atteris were the designers of the shore crossing and the project managers for the drilling & blasting, and dredging contract, and supervised the nearshore pipeline installation on behalf of Woodside.

Despite these comments, drilling and blasting is viewed as the last option should the rock offshore prove too strong to be broken with a backhoe dredge fitted with a rock breaker and will be avoided wherever possible.

Offshore equipment may accidentally release hydrocarbons into the water. Adequate environmental management plans and procedures will need to be prepared and implemented to manage this risk.

Vessels have been known to transport introduced marine species. Australian maritime laws provide particular quarantine measures for vessels travelling from international water. Further measures can be specified to domestic vessels to ensure that the risk of introducing foreign marine species is minimised.

4.2 Summary of Opinions on Alternatives

Horizontal Directional Drilling

HDD will not be a viable method for the installation of this outfall pipeline across the shore, for the following reasons:

- Onshore coring conducted on the site shows ground conditions consisting of highly weathered, fractured and vesicular basalt rock, the potential presence of a palaeo channel and the consequential presence of cobble and gravel beds along the drilling alignment. This will pose extremely high risks of failure of this installation method, considering the large diameter borehole (approx 1.3 m) which is required
- The length of the outfall pipeline (approximately 2800 m) exceeds the length of HDD feasibility for this large pipeline diameter. For HDD to be applied, the alignment will have to be partly drilled (e.g. out to the 10 m water mark) with the remainder installed in a pre-dredged trench (i.e. dredging equipment will be required for the remainder of the outfall section).
- A HDD site footprint for this size project will require a flat hardstand area of between 3000 sqm and 5000 sqm. This includes an area for a water basin for storage of fresh water for use during drilling and hole opening operations. An access track suitable for heavy construction equipment will also need to be constructed from the nearest main road to the site.
- To avoid major impact to the foreshore dunes the HDD entry point onshore will need to be located south of the dune area in the agricultural land approximately 650 m from the shoreline. This additional length further diminishes the feasibility of a drilled solution.
- The pipeline string must be pre-fabricated in one continuous length, which offers limited flexibility for the onshore stringing area and will impact the environmentally sensitive area south of Aerodrome Road.
- The HDD exit point will have an angle with the seafloor of 4 degrees minimum, which will create a large overbend in the pipeline, causing potential pipeline installation and stabilisation problems.

Using smaller, multiple HDD's has been considered, however it is not considered technically feasible as outlined below.

To cross from behind the dune area and through the surf zone, a length of 1800 metres is required to be drilled. However this has some significant downsides including:

- Theoretically, a 300 mm diameter pipeline may be used, however 8 – 10 pipelines are required to be installed to provide the same capacity as the proposed 900 mm ID pipeline.
- 8 to 10 pre-fabricated 2000 m pipestrings would be required to cross into the sensitive area south of Aerodrome Road, vegetation would be required to be cleared for survey lines.
- Larger width of dredging is required to situate all the pipelines beyond the surf zone.
- Poor results achieved on many drilled shore crossings, including those for small diameter pipelines over relatively short distances, indicate that significant problems can be expected if HDD was pursued for the Pulp Mill Outfall. There is a high risk of not being able to complete the project. Two previous projects in the vicinity of the proposed outfall have used HDD as part of their construction methodology (Duke Energy's Gas Pipeline Installation at Five Mile Bluff and the dune crossing for BassLink). However, the length and diameter of these crossings were substantially less than the proposed Gunns outfall and it is not appropriate to compare them. One

of them, which comprised the installation of a 350 mm diameter pipeline over a length of 860 m, experienced significant problems and a 250% schedule overrun.

Additionally there is still the requirement to prefabricate onshore and tow out to sea the remaining section of the outfall pipeline, requiring the preparation of a stringing and launching site onshore and therefore the dune disturbance will only be marginally reduced.

Other Methods

Micro-tunnelling is a steerable form of pipe-jacking. The nature of the machinery and the length of the outfall requires the need for man access to maintain the equipment. The small diameter (900 mm) of the proposed outfall does not provide suitable clearance for man access and therefore it is not considered a feasible or safe option for the construction of the entire outfall. Using micro-tunnelling to cross the entire dune area (approx 700 m) is also not considered appropriate, as the pipeline corridor has the dual use of providing a launching alignment for the offshore pipeline. It is not practicable to launch an offshore pipeline through such a long tunnel.

Auger boring is a non-steerable form of pipe-jacking and is only suitable for installing short length of pipeline (< 70m depending on diameter). It is not considered a feasible method of constructing the outfall.

Pipestringing Corridor

With the proposed outfall construction method the outfall pipeline string should be pre-fabricated in several shorter lengths of 200-250 m sections in view of the onshore environmental constraints and the onshore topography (Figure 4.1). Attachment 3 shows the proposed onshore stringing alignment. A single pipeline string would impact on many identified environmentally sensitive areas.

Figure 4.1

Typical Overview of Pipe String Launching Operation (Several Strings)

Figure 4.2

Typical Overview of Pipe String Launching Operation (Several Strings)

The onshore alignment has been planned to avoid the area south of Aerodrome Road which has been identified by other studies as being environmentally sensitive and a technically suitable stringing and launching site has been identified approximately 1 km onshore. The alignment has been designed to minimise impact on the areas of threatened rare and endangered flora species as well as a local heritage site. 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 (Figure 4.2). Where excavation is necessary, material will be stockpiled in designated areas clear of identified sensitive vegetated communities. Additionally, the stringing alignment is to be utilised for the onshore pipeline. Excavations for the stringing alignment will be used as part of the trench for the onshore pipeline installation.

To minimise impact on a sand dune supporting Xanthorrhoea aff. bracteata, it is proposed to install part of the onshore pipeline and launching section under the dune by pipe jacking. The installed 1.5 - 1.8 m diameter casing pipe underneath the dune, can be used for both the pipeline launching operations and the onshore pipeline. Attachment 4 shows the proposed crossing passing 6 m under the dune.

5 Provisional Opinion

The opinions that I have expressed in this report are based on my experience and the experience and advice provided to me by Gunns Limited and the consultants engaged to carry out specialist studies for the Bell Bay Pulp Mill Project. Subject to any limitations and exclusions identified in this statement, my opinions are complete and accurate in every respect.

I am satisfied through my inquiries that the opinions I have expressed are reasonable in regard to the design and construction of the ocean outfall pipeline.

6 Declaration

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have, to my knowledge, been withheld from the Commission.

Eric Pieter Jas

Attachment 1
Curriculum Vitae

Personal Details

Surname:	Jas
First Name:	Eric
Residency:	Perth, Western Australia

Professional Qualifications

Bachelor of Civil (Coastal) Engineering, University of Technology of Dordrecht, The Netherlands (1985).

EurIng (European Engineer)

Employment History

1999 – Present	7 years	– Atteris Pty Ltd
1996 – 1999	3 years	– JP Kenny Pty Ltd
1986 – 1996	10 years	– Visser & Smit Hanab BV – Royal Volker Stevin Group
1985 – 1986	14 months	– Armed Forces (National Service)
1984	6 months	– Visser & Smit Hanab BV – Royal Volker Stevin Group

Professional Affiliations

Member, The Netherlands Association of Engineers.

Courses

2005	PADI Scuba Diving
2005	OPITO Tropical Offshore Safety Induction & Emergency Training
2004	Managing HSE
2001	Advanced Safety Auditing Training
2000	Job Hazard Analysis Training
1999	HUET & Aviation Survival / Basic Sea Survival Training
1998	First Aid Training
1996	Project Management Course
1994 – 1996	Safety in Petrochemical Industry
1992	Junior Management Course
1989 – 1990	Organisation Course
1988	Contract Conditions Course
1985 – 1986	Land Surveyors Training – Armed Forces

Experience Summary

Over twenty years experience with the design and construction of onshore and offshore pipelines, with the main areas of expertise as detailed below. Extensive experience in all phases of pipeline projects, including: feasibility studies, conceptual design, route surveys, front-end engineering and detailed design, development of tendering and contracting strategies, tender preparation, cost estimating, construction risk analysis, construction planning, construction supervision and project / contract management. Geographical experience covers: Europe, Asia and Australia.

Currently owner and operator of engineering company Atteris Pty Ltd, based in Perth, Western Australia

Extensive Design and Construction Expertise

- Pipeline Shore Approaches and Shore Crossings (Conventional and Drilled)
- Ocean Outfalls
- Pipe Pulls (Shore Pulls and Tow-Outs)
- Horizontal Directional Drilling
- Dredging and Underwater Drilling & Blasting
- Pipeline River and Channel Crossings (Conventional and Drilled)
- Pipeline Trench Pre-Dredging and Backfilling
- Pipeline Rock Dumping

Extensive Design Expertise

- Pipeline Stabilisation Design
- Pipeline Rock Cover (Rock Berm) Design
- Pipeline Freespan Analysis
- Geotechnical Engineering (Onshore and Subsea) and Shoreline Geomorphology
- Onshore, Shoreline and Offshore Geophysical and Geotechnical Surveys

Other Expertise

- Offshore Pipelay (S-lay)
- Onshore Pipeline Construction
- Rock Quarrying and Rock Dumping
- Subsea Gravity Anchors (Concrete Mattresses)
- Subsea Pipeline Post-Trenching Methods (Mass-Flow-Dredging, Ploughing, Jetting)
- Pipe External Corrosion and Abrasion Coatings
- Sediment Transport and Scour
- Risk and Safety Assessment
- Pipeline Protection Design
- Pipe Welding and Field Joint Coating (Steel Pipelines)
- Pipe Welding (PE Pipelines)
- Pipe Weld NDT (X-Ray and UT)
- Onshore Pipeline Construction
- Auger Borings, Micro-Tunneling
- General Civil Construction

Project Administration and Management Expertise (Design + Construction Phases)

- Cost Estimating (Extensive Expertise)
- Planning Engineering (Extensive Expertise)
- Contract Administration and Management (Extensive Expertise)
- Development of Tendering and Contracting Strategies (Extensive Expertise)

Professional Experience

ATTERIS PTY LTD (1999 – Present)

Providing design and construction support services to pipeline projects from feasibility stage through to construction.

2005 – Present.

Managing Director of Engineering Company Atteris Pty Ltd. Day-to-day management of engineering company, including acting project manager on a range of engineering and construction projects, including:

- Offshore and Onshore Pipelines
- Pipeline Shore Approaches and Shoreline Crossings
- River and Channel Crossings
- Ocean Outfalls
- Micro-Tunnelling and Thrust (Auger) Boring
- Dredging and Land Reclamation

2001 – 2005.
Woodside Energy – Otway Development Project, Otway Basin, Victoria, Australia. Contract for design and construction management of shore crossing for 20-inch gas export pipeline and 4-inch service line.

- Detailed feasibility study of shore crossing considering a range of construction methods, including, open excavation, horizontal directional drilling and micro-tunneling, including an investigation into the geology and geomorphology of the shoreline, undertaking a series of detailed site visits, cliff stability studies, landfall site selection studies, shore crossing conceptual design, development of shore crossing installation methods based on horizontal directional drilling, preparation of cost estimates, provision of input to EES/EIS, attend meetings with environmental government departments, and provision of input to onshore and offshore pipeline route geophysical and geotechnical survey programs.
- Performing a study of supply and placement of quarry rock for pipeline stabilisation.
- Development of tender and contracting strategies for shore crossing construction.
- Design including development of detailed construction methodology for shore crossing by horizontal directional drilling.
- Development of geotechnical survey program for shore crossing area and offshore pipeline route.
- Preparation of invitation to prequalification packages for shore crossing construction by horizontal directional drilling, review prequalification submissions, and recommend tender list.
- Preparation of invitation to tender packages, tender evaluation and contract negotiations for shore crossing construction contact.
- Management and administration of shore crossing construction contract.
- Assist engineering team regarding offshore pipeline stabilisation design, including seabed liquefaction and scour assessments.

2004 – 2005.
Chevron Australia – Gorgon Field Development, North West Shelf, Western Australia. Conceptual engineering design of pipeline shore approach at Barrow Island's western shoreline in relation with the Gorgon Gasfield Development.

- Review of site data.
- Visual inspection of candidate pipeline landfall sites.
- Development of landfall construction methods considering open-cut and trenchless technologies.
- Shore approach and shore crossing preliminary design.

2000 – 2003
Woodside Energy – Trunkline System Expansion Project, North West Shelf, Western Australia. Contract for pipeline stabilisation design, and for design and construction management of shore crossing for 42-inch gas export pipeline.

Leading the engineering design team, including specialist subcontractors (geotechnical engineers, metocean consultants, seabed scour consultants) for preliminary and detail design of a pipeline protection and stabilisation system for 134 km of 42-inch gas trunkline in an area affected by tropical cyclones.

- Shore crossing design.
- QRA and pipeline protection design.
- Design of stabilisation system based on a combination of pre-dredging and sand backfill, rock dump and concrete gravity anchors.
- Development of cost estimates and time schedules for different pipeline stabilisation options.
- Provision of input to tender and contracting strategies for construction contracts (pipelay, dredging, rock quarrying and rock dump).
- Preparation of invitation packages for prequalification and tender for construction contracts, including review of prequalification and tender submissions.

Management and administration of shore crossing construction contact, comprising the dredging of 7 km of nearshore pipeline trench using a range of dredging methods (subsea drilling & blasting, backhoe dredging, and trailing suction hopper dredging)

- Development of tendering and contracting strategy.
- Pre-award contract negotiations.
- Administration and management of dredging contract comprising underwater drilling & blasting operations near live LNG Plant, live Gas Pipeline and operational LNG and LPG Jetties, backhoe dredging and trailing suction hopper dredging; seabed materials comprising igneous hard rock, calcareous sedimentary rock and silty sands.
- Construction engineering.
- Directing 5 site inspectors, liaison with onshore gas plant operators and pipelay contractor.
- Assist with site supervision during critical operations (drilling & blasting, trench completion prior to pipelay, and shorepull operation).
- Evaluation and negotiation of variations and claims.
- Contract close-out.
- Contract was completed within time, under budget and without LTIs.

Also assisted Woodside team with design and construction management of dredging a 25 km offshore trench in up to 50 m water depth by trailing suction hopper dredging, and design verification / field supervision of shore pull operation.

2002

Kellogg Brown & Root – Kepodang Field Development Project, Central Java, Indonesia. Contract for provision of assistance to KBR with design and construction preparation of shore approach, shore crossing and onshore section of a 14-inch gas export pipeline from BP's Kepodang Field to Semarang, Central Java.

- Conceptual design of pipeline shore approach and shore crossing, onshore route selection, considering open cut and horizontal directional drilling.
- Evaluation of tenders from construction contractors.

2002

BP – Tangguh Gas Project, Irian Jaya, Indonesia. Contract for assistance to BP with design and construction preparation of shore approach and shore crossing of two medium sized gas export pipelines, 20-inch and 24-inch in diameter, in Burau Bay, Irian Jaya.

- Preliminary design of pipeline shore approach and shore crossing considering open cut and horizontal directional drilling, including performing a detailed site visit.
- Provision of input to geotechnical surveys.
- Evaluation of tenders from construction contractors.
- Develop detailed construction methodology for shore crossing construction.
- Prepare invitation to prequalification packages for shore crossing construction by horizontal directional drilling, review prequalification submissions, and recommend tender list.

2002

Woodside Energy – Blacktip Gas Project, Bonaparte Gulf, Australia. Contract for preliminary design of shore approach and shore crossing for a medium size gas export pipeline, near Wadeye, Northern Territory, Australia.

- Perform desk study of the area, identification and evaluation of a range of pipeline landfall sites, including an investigation into the geology and geomorphology of the shore approach area and shoreline.
- Preliminary design of pipeline shore approach and shore crossing considering open cut and horizontal directional drilling, including performing a detailed site visit.
- Develop construction methodology.
- Develop cost estimates for comparison of different methods / landfall sites.
- Provide input to pipeline route survey programs.
- Review of tender submissions from pipeline construction contractors.

2001

JP Kenny – Shore Crossing by Horizontal Directional Drilling, Victoria, Australia. Provision of ad-hoc support for pipeline shore crossings by horizontal directional drilling in Bass Strait, Victoria, including evaluation of shore crossing design and review of construction specifications.

- Design validation for shore crossing for OMV's Patricia Baleen Gasfield Pipeline System.
- Review of construction specifications for shore crossing for BHPB's Minerva Gas Field Pipeline System.

2001

Allseas – Victoria to Tasmania Gas Pipeline, Australia. Review of shore crossings design and shore crossing construction tenders for Duke Energy's 14-inch gas pipeline (shore crossings at either end of pipeline constructed by horizontal directional drilling).

2000

Genesis Oil & Gas – Sunrise Gas Project, Timor Sea, Australia. Conceptual design of gas export trunkline in the Timor Sea with a landfall in the Darwin area. The project comprises 500 km of subsea gas pipeline (including a 15 km onshore section) with diameter options from 26 to 34-inch for Shell Australia / Woodside Energy. In a team of 4 pipeline engineers and liaising with a range of people of other disciplines, responsible for shore approach routing and landfall site selection, shore approach and shore crossing preliminary design, pipeline route reconnaissance survey preparation and technical coordination of geophysical and geotechnical surveys, quarried rock supply studies (for pipeline route preparation and stabilisation), pipeline external impact protection QRA/conceptual design, input to metocean data collection program, interface on technical matters with local government and native title coordinator in Darwin, input to cost estimate and project time schedule, and development of construction and contracting strategies.

2000

OMV Australia – Shore Crossing Study, Bass Strait, Victoria. Feasibility study for shore approach and landfall of a 16-inch gas export pipeline in Bass Strait, Victoria. The study comprised an investigation into the geology and geomorphology of the shoreline, landfall site selection and workspace requirements definition, assessment of onshore pipeline routing options, and recommendations for geotechnical survey programs.

2000

Woodside Energy Limited – Shore Crossing Study for Kipper Field, Bass Strait, Victoria. Detailed feasibility study for the construction of a shore approach and landfall of a gas and oil export pipeline system in Bass Strait, Victoria. The study included an investigation into the geology and geomorphology of the shoreline, performing a detailed site visit, landfall site selection for a range of gas treatment plant locations, shore crossing conceptual design, development of shore crossing installation methods based on horizontal directional drilling, preparing cost estimates for different landfall options, and provision of input to pipeline route survey programs.

1999

Hyundai Heavy Industries – Shore Crossing Assessment, Taiwan. Provision of consultancy services for CPC's 36-inch gas pipeline installation across the shore at Yung-An, Taiwan after failed attempt by a subcontractor to install the shore crossing by horizontal directional drilling, horizontal drilling length 1000 m. The consultancy services included assessment of the failure reasons and recommendations for successful completion of shore crossing construction. The crossing was subsequently successfully installed.

J P KENNY PTY LTD (1996 - 1999)

1999

West Australian Petroleum – Thevenard Island Shoreline Protection, Western Australia. Project Manager responsible for design and construction of a shoreline protection system. The project included preparation and management of a geotechnical survey program, design of the shoreline protection system, cost estimating, risk analysis, preparation of scope of work, construction specification and drawings, assembly of invitation to bid documents, evaluation of bids, pre-award negotiations, and construction management. The position included management of a team of 4 engineers/draftsmen, and acting as focal point for the client and construction contractor.

1999

West Australian Petroleum – Subsea Pipeline Repair, Western Australia. Senior Project Engineer responsible for the repair of cyclone damaged subsea pipelines. The project included performing a fitness for purpose assessment and development of scope of remedial work.

1999

Conoco Indonesia – West Natuna Transportation System, Singapore and Indonesia. Review of contractor provided work procedures and QA/QC documentation for rock quarrying operations. The rock was required to cover the shore approach section of the 26-inch Trunkline.

1999

Woodside Energy – Pipeline Stability Assessment, Western Australia. Senior Project Engineer responsible for the stability assessment of existing subsea pipelines. The assessment included the development of the scope of work for SSS and ROV surveys, definition of functional specifications, analysis of the survey results and performance of the engineering assessment consisting of freespan and rock berm stability analysis.

1999

First Gas Pipeline Corporation – Tabangao to Santa Rita Natural Gas Pipeline, The Philippines. Conceptual design of Calumpang and Marjoya Rivers crossing by directional drilling. Crossing length 900 m for a 24-inch gas pipeline.

1999

Woodside Energy – Atoll Slope Crossing by Directional Drilling, Australia. Senior Project Engineer responsible for performing a feasibility study into installing a section of a gas trunkline across a steep subsea atoll slope by directional drilling.

1999

Woodside Energy – EPRS, Mass-Flow-Dredging. Senior Project Engineer responsible for the development of an Emergency Pipeline Repair System based on Mass-Flow-Dredging (MFD). The project included an investigation of MFD technology available worldwide, technical suitability analysis, cost and risk analysis, and development of an EPRS procedure.

1998

Shell Australia / Woodside Energy – Sunrise/Troubadour Pipeline Project, Timor Sea. Senior Project Engineer responsible for performing a feasibility study for the shore approach and landfall construction of a major gas export trunkline in an area of strong tidal currents and hard/rough seabed. The feasibility study included the selection of candidate landfall sites, performing a detailed site visit, communicate with the native population, develop work methods, perform preliminary stabilisation design, costing and scheduling, and risk analysis.

1998

Resak – Beranang Development Project, Malaysia. Engineering Specialist providing input to the design of a 28-inch pipeline shore crossing by directional drilling.

1997 – 1998

Woodside Offshore Petroleum - Second Trunkline Project, Western Australia. Supervising Engineer responsible for the shore approach design of a major gas trunkline in an area of cyclonic activity and seabed instability. Responsible for design and contract preparation of pipeline shore approach, landfall, dredging, rock dumping and stabilisation works. Auxiliary studies included geotechnical studies, liquefaction studies, pipeline trenching studies (ploughing, jetting, mass flow dredging, deep dredging), the preparation and supervision of field blasting tests on an LNG plant, pipeline routing studies, and cost estimating and risk assessments. Other responsibilities included the development of tendering and contracting strategies for shore approach construction, including pipelay and dredging, and stabilisation works. Furthermore acted as a project interface focal point with LNG plant operators, and Woodside Geomatics Department.

1996

West Australian Petroleum - Gorgon Field Export Pipeline Project, Western Australia. Senior Project Engineer on a conceptual design contract of a large diameter trunkline (diameter options up to 46-inch) from the Gorgon Gasfields to shore (North West Shelf, Western Australia). Responsible for pipeline stabilisation design, shore approach and shore crossing design for a range of landfall options, and geotechnical studies.

VISSER & SMIT HANAB BV, THE NETHERLANDS (1992 - 1996)

Horizontal Directional Drilling Projects, Europe. Senior Project Coordinator and Lead Estimator / Tender Leader for pipeline river/canal crossings, road and railway line crossings, and shoreline crossings by horizontal directional drilling. Responsibilities included marketing, business development, review of invitation to bid documents, contract evaluation, both bid-phase and detailed design, cost estimating, risk analysis, bid preparation, project-coordination and contract management. Drilling projects included both single and multiple pipelines (bundles), in steel and PE, with lengths ranging from 250 m to over 1000 m, and pipeline diameters up to 48-inch. Drillings were performed in a wide range of geotechnical conditions, including soft muds and silts, a variety of clays, sands, gravels, and rock formations. Tendering was performed worldwide, projects were executed across Europe. A summary of the major crossings is presented below, although the responsibilities also included supervision of a junior project coordinator for mini- and midi rig crossings, which generally involved the installation of PE ducts across roads, railways, rivers and canals over lengths less than 200 m, and which are not listed in this c.v.

Summary of Major Horizontal Directional Drilling Projects:

Client	Crossing	Location	Pipeline(s)	Length
WBB	Freeway A15	Barendrecht, Holland	Twin 48" water main.	680 m
Ruhrgas	Lippe-Datteln Canal	Hamm, Germany	12" gas main	240 m
Verbundnetz Gas	Unterwarnow River and Railway Lines	Rostock, Germany	20" gas main + 4 x 4" cable ducts (pipe bundle)	850 m + 550 m
Municipalizzati Mantova	Lago Superiore	Mantova, Italy	10" gas main	750 m
Welsh Water	Shore Crossing	Aberdyfi, Wales	6" steel sewer outfall	170 m
RMR	Rhein-Herne Canal	Bottrop, Germany	20" + 4" + ½" (pipe bundle)	680 m
WLZK	Noordzee Canal	Velsen, Holland	24" water main	620 m
EWR	Canal and Railway line	Lisse, Holland	20" water main	310 m
WZHO	Canal and Freeway A15	Schelluinen, Holland	12" sewer line	490 m
WZHO	River Oude Maas	Puttershoek, Holland	20" + 4" (pipe bundle)	540 m
Wintershall	Conrebbers Road	Emden, Gemany	36" gas trunkline + 2 x 4" cable ducts (pipe bundle)	730 m
Tamoil	River Adda	Crema, Italy	10" oil line	330 m
NUON	River Rhine	Arnhem, Holland	20" water main	600 m
Gaz de France	Two Canals	Aire-sur-la-Lys, France	10" gas main	220 m + 190 m
Southern Water	River Yar	Isle of Wight, England	180 mm HDPE	260 m
Clark	River Severn	Upton upon Severn, England	2 x 315 mm HDPE	200 m
Gaz de France	Canal and Roads	Calais, France	4" and 6" gas mains	230 m
NATO	Ringvaart Canal	Roelofarendsveen, Holland	12" fuel line	500 m
Murphy Bros	Beach Crossing	Point of Ayr, England	24" oil line	300 m
SNAM	Candiano Canal	Ravenna, Italy	16" + 24" gas mains	590 m
South West Water	Shore Crossing (Outfall)	Lyme Regis, England	315 mm HDPE sewer outfall	660 m
Clyde Petroleum	Parallel Road	Waalwijk, Holland	10" gas line + 125 mm HDPE	690 m
Gaz de France	River Savoureuse	Belfort, France	20" gas line	510 m
Gasunie	River Gaasp	Diemen, Holland	30" gas line	1160 m
WBE	River Kil	's-Gravendeel, Holland	32" water main	500 m
WBE	Highway N3	Dordrecht, Holland	32" water main	490 m
WBE	Freeway A16	Dordrecht, Holland	32" water main	490 m
Eneco	Binckhorst Road and Railway Lines	The Hague, Holland	Twin 16" / 560 mm steel-pur-PE (city heating lines)	390 m
Frevar	River Elve	Frederikstad, Norway	500 mm water main+ 600 mm sewer line + 125 mm cable duct (all HDPE)	450 m
Water Board Rijnland	Freeway A44 + East Vinken Road + West Vinken Road + Soccer Field	Sassenheim, Holland	560 mm HDPE sewer line	850 m + 550 m + 500 m + 275 m
WBE	Kruithuis Road	Delft, Holland	40" water main	680 m
Gaz de France	Route Nationale 57	Nancy, France	4" gas main	950 m
Gasunie	Noord Hollands Canal	Alkmaar, Holland	36" gas main	660 m

Summary of Major Horizontal Directional Drilling Projects (Con'd):

Client	Crossing	Location	Pipeline(s)	Length
Delta Nutsbedrijven	Grevellingendam	Bruinisse, Holland	16" water main	1255 m
Dutch Telecom	Hartel Canal	Rotterdam, Holland	315 mm HDPE	500 m
Distrigas	Schipdonk Canal + Canal Gent-Oostende	Nevele, Belgium	16" gas main	360 m + 390 m
Electricité de France	River Saone	Lyon, France	7 x 200 mm HDPE cable ducts (bundle)	300 m
Amoco	Shore Crossing (not completed)	Maasvlakte, Holland	26" gas line	1450 m
Statoil	Shore Crossing (design contract)	Mongstad, Norway	16" oil line (Troll Oil Pipeline)	900 m

Additionally, consultation was provided for the design and construction of new drilling and ancillary equipment, including an in-house designed 200-tonne pulling capacity tracked drilling rig.

JOINT VENTURE LANDFALL ZEEBRUGGE, (1990 - 1991)

Statoil - Zeepipe Gas Pipeline Landfall, Belgium – Design and Construction Contract. Lead Estimator/Tender Leader and subsequently Senior Project Engineer on landfall construction project for 40-inch Zeepipe Gas Trunkline. During tender period responsible for landfall design coordination (both horizontal directional drilling design and open cut design options), cost estimating, cost escalation risk analyses, tender documents preparation, joint venture negotiations and contract negotiations with client. During design and construction responsible for project management support, quantity surveying, planning engineering and progress reporting, budget preparation, cost control, purchasing and procurement, preparation of work procedures, site supervision, safety engineering and QA/QC. Construction activities included:

- Geotechnical sampling using jack-up barge.
- Dredging and backfill operations by cutter suction dredging and side dump vessel.
- Sheetpiled cofferdam construction.
- Rock bunds construction and sand fill operations.
- Shore pull operation (400 tonne pull-set-up).
- Pipe welding qualifications, pipe production welding, NDT and field joint coating (heat shrink sleeves and neoprene rubber).
- Pipeline hydro-testing.

THE DREDGING & CONSTRUCTION COMPANY, UK (1989)

Southern Water Authority - Long Sea Outfall, England. Site Engineer / Deputy Project Manager for the construction of a 2.6 km, 26-inch long sea outfall in Seaford Bay, East-Sussex. Responsibilities included site engineering and surveys, cost-control, site administration and supervision of following construction activities:

- Pipe stringing site preparation and clean-up.
- Pipe welding, NDT (X-ray and UT) and field joint coating (wrapping tape followed by concrete infills).
- Shoreline sheetpiled cofferdam construction.
- Pipeline trench dredging and backfilling operations (cutter suction and trailing suction dredging).
- Launchway installation (roller-track).
- Pipe bottom-pull (in charge of pulling operation using winch barge), 200 tonne pull set-up.
- Subsea construction of diffusers, including concrete covers (diving operations).

VISSER & SMIT – READING & BATES JOINT VENTURE THE NETHERLANDS (1988)

Water Company Hollandse Eilanden en Waarden – River Lek Crossing by Directional Drilling, The Netherlands. Project engineer for the design, construction and installation by directional drilling of a 630 m, 20-inch pipeline across the River Lek, The Netherlands.

- Review of invitation to bid documents, bid-phase design, risk analysis and cost estimating. Preparation of bid documents. Attended pre-award negotiation meetings in the role of project engineer and cost estimator to support contract manager.
- Upon contract award, coordinated design work, prepared construction procedures and project budget / time schedules.
- On own request, started on the project as a drill floor hand, handling and connecting drill pipe, drill motors and reamers, as part of the drilling team.
- Then assisting mud engineer with mixing and testing drilling bentonite, followed by assisting with the design and rig-up of the drilling mud re-circulation system.
- Finally assisted project manager with the supervision of the pipe-string assembly (stringing, welding, NDT and pressure test) and pullback operation.

VISSER & SMIT HANAB, THE NETHERLANDS (1986 - 1988)

Junior Engineer / Cost Estimator - Pipeline/Cable Projects. Cost estimator for onshore and shallow water pipeline projects, river crossings, road crossings, outfalls, landfalls and cable projects in Europe and West-Africa.

- Review of invitation to bid documents, including scope of work, specifications, survey data and contract conditions.
- Perform bid-phase design, including construction engineering.
- Obtain subcontractor and supplier proposals.
- Perform risk analyses and prepare cost estimates / time schedules.
- Prepare and issue bids.

ARMED FORCES, THE NETHERLANDS AND GERMANY (1985 - 1986)

National Service - Artillery. Battery Sergeant responsible for field survey operations in The Netherlands and Germany.

VISSER & SMIT HANAB BV, THE NETHERLANDS (1984)

Trainee – Pipeline and Cable Project. Junior Project Engineer on pipeline construction and high voltage cable installation project on Shell Refinery, Pernis, The Netherlands. Responsible for field survey works, field supervision, material procurement and safety.

Attachment 2

Effluent Outfall Diffuser Location

Effluent Outfall: Diffuser Locations

488345, 5460968

488365, 5460769

Diffuser Length: 200 m

Diffuser Location assumed in Aquenal's Marine Outfall Report in the draft IIS, Vol 11, Appendix 24
Additional Effluent Pipeline Length: 258 m

Effluent Pipeline Offshore Length including Diffuser = 2942m

488000 488500 489000 489500 490000

5461000 5460500 5460000 5459500 5459000 5458500 5458000

Legend

- Relocated Diffuser Location
- Original Proposed Diffuser Location
- Atteris Diffuser Locations
- MarineEcology_FishVideo
- MarineEcology_Particle
- 1km_DiffuserExclusion

Effluent Pipeline

- Proposed Effluent Pipeline
- Original Effluent Pipeline
- Basslink
- Low Head Cadastre

Sea Bed Features

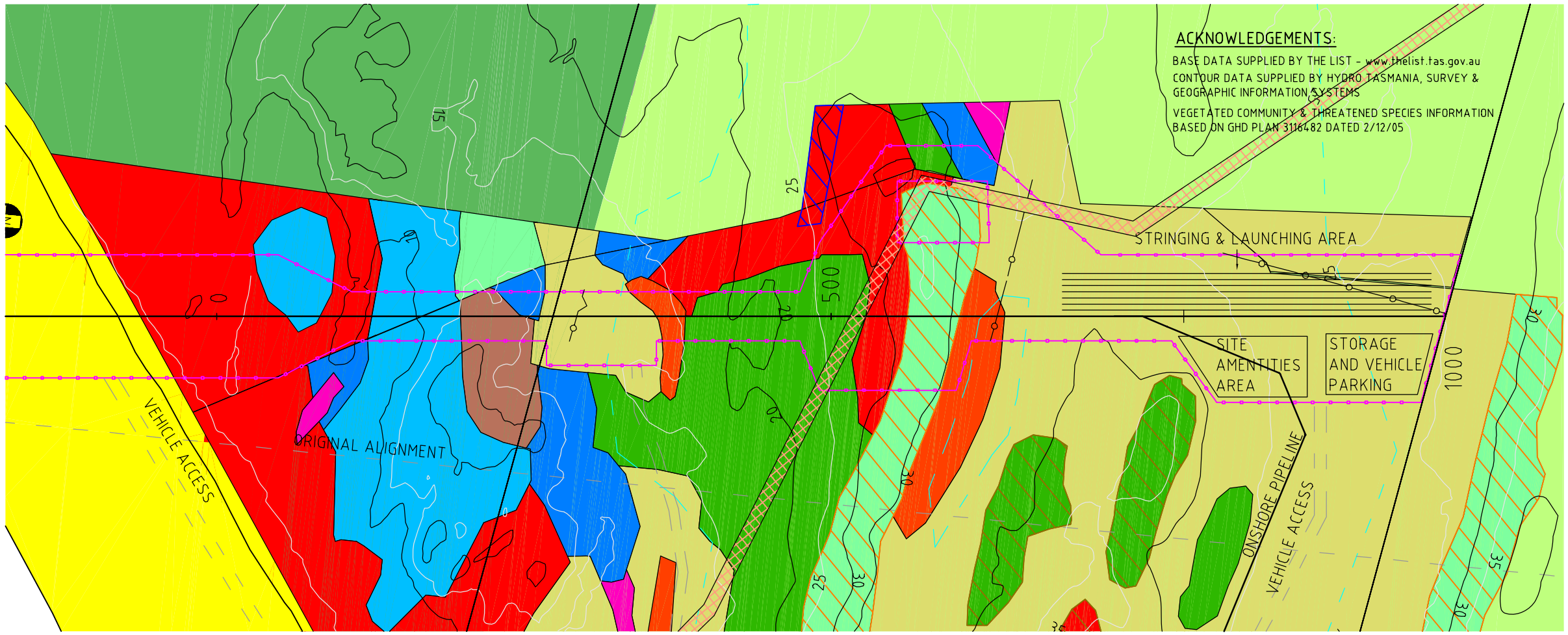
- Coarse Sand/Fine Gravel
- Irregular Basalt Outcrops up to 2m
- Low scattered outcrops with thin patchy sand cover
- Sandy Seabed

0 62.5 125 250 375 500
Meters

Projection: GDA 94 Zone 55
Source: Cadastre: the LIST- www.thelist.tas.gov.au;
Basslink Alignment: National Grid; Seabed features & contour data: Atteris; Benthic Survey: Aquenal; Imagery: Hydro Tasmania.
Date: 11-12-06
File:R:\RITWORK\Tys\PULPMILL\Projects\EffluentOutfall_SiteLocation&Benthic_change_GS_061211.mxd

Attachment 3

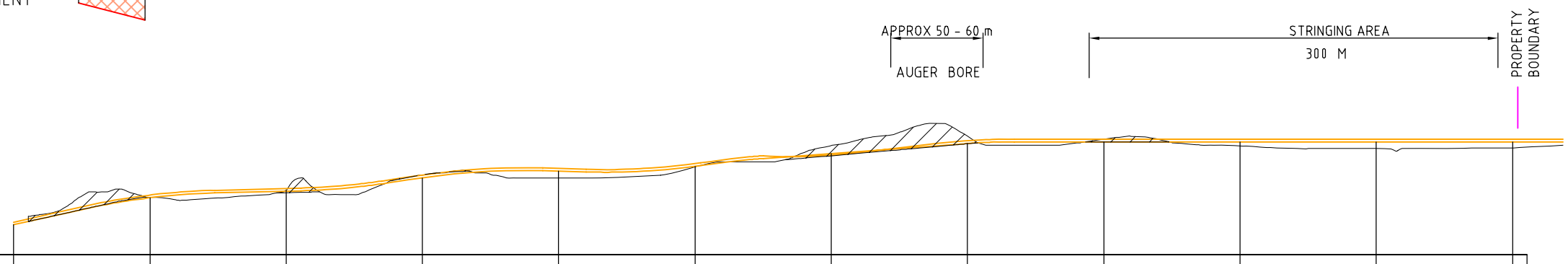
Onshore Stringing Alignment



PLAN
1:4000

BRACKEN FERN (FPF)
GRASSLAND (GSL)
COASTAL SCRUB (SAC)
MARRAM GRASSLAND (FMG)
MELALEUCA ERICIFOLIA (NME)
ARGRICULTURAL (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
EXCAVATION
CONTOUR (MAJOR) 30
CONTOUR (MINOR) 25
SITE BOUNDARY
WATERWAY
EXISTING FENCELINE
BASSLINK EASEMENT
PIPELINE STRING

LEGEND



DATUM R.L.-14.00

NATURAL SURFACE		7	9.601	15.164	14	18.122	25.93	29.399	28.287	25.782	24.817	25.016
PIPELINE	-3.093	6.818	9.265	14.104	16.57	18.305	23.069	26.732	27.326	27.326	27.326	27.326
CHAINAGE	-100	0	100	200	300	400	500	600	700	800	900	1000

LONGITUDAL SECTION
HORIZONTAL SCALE 1:4000
VERTICAL SCALE 1:2000

ATTERIS PTY LTD
LEVEL 6, 68 ST GEORGE TCE
PERTH WA 6000
PO BOX 7305
CLOISTERS SQUARE WA 6850

DRAWING No	REFERENCE DRAWINGS	REV No	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	APPROVED	CLIENT
		2	7/12/05	UPDATED EVCS AND THREATENED SPECIES	DRC	EJ	EJ	
		1	18/10/05	UPDATED WITH FURTHER INFORMATION	DRC	EJ	EJ	
		0	22/9/05	ISSUED FOR APPROVAL	DRC	EJ	EJ	

CLIENT: Gunns LIMITED

DRAWN: D.CAMPBELL DATE: 22/09/05
CHECKED: E.JAS DATE: 22/09/05
APPROVED: E.JAS DATE: 22/09/05
CLIENT: DATE:

BELL BAY PULP MILL
OCEAN OUTFALL STRINGING AND LAUNCHING ALIGNMENT

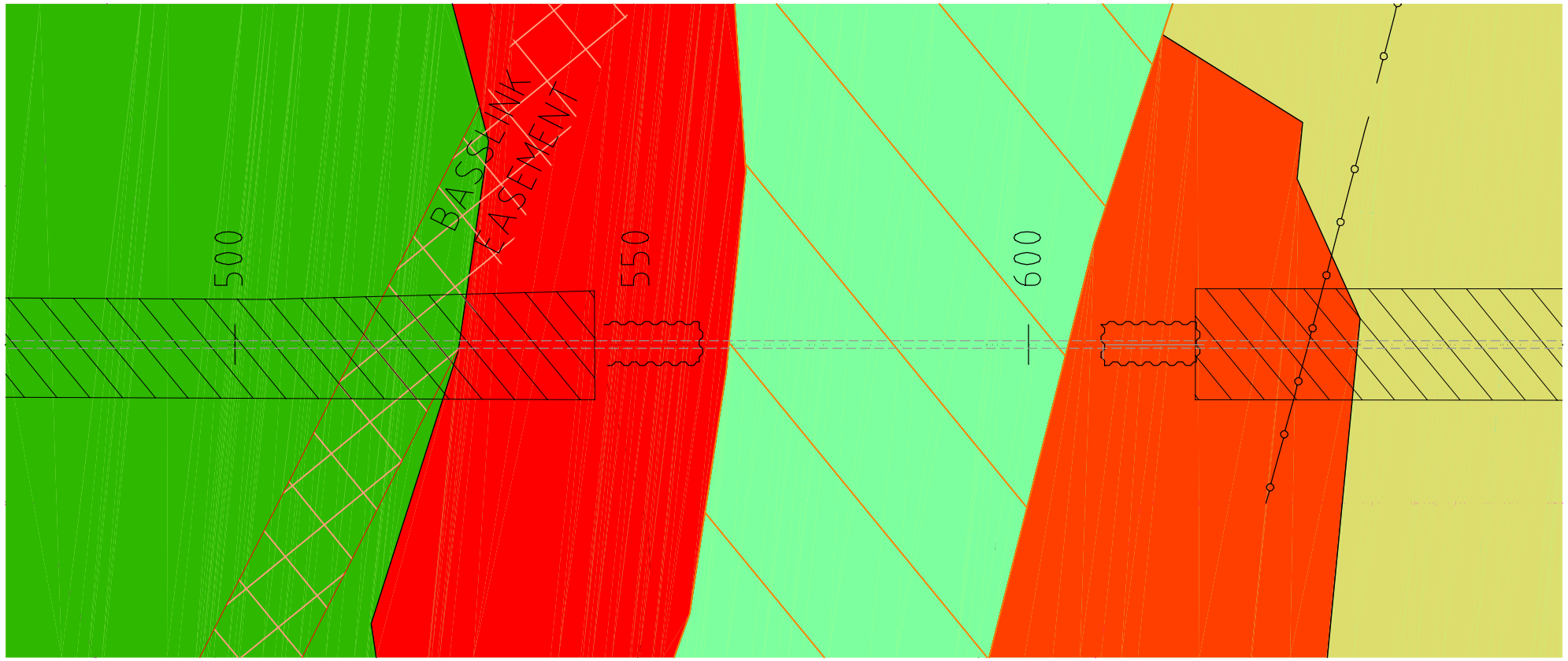
SCALE: AS SHOWN | A3 | DWG No 05-003-D-002 | REV 2-P

Attachment 4

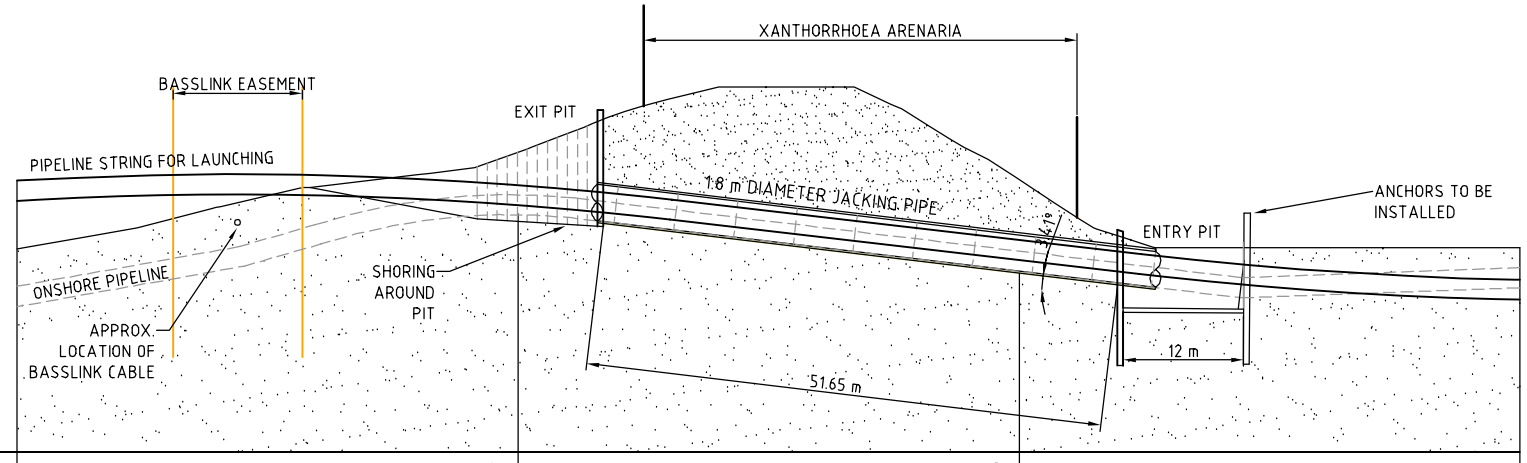
Dune Crossing

BRACKEN FERN (FPF)
GRASSLAND (GSL)
COASTAL SCRUB (SAC)
ARGRICULTURAL (FAG)
LACUSTRINE HERBLAND (AHL)
XANTHORRHOEA ARENARIA & BACTTEATA, ACAIA ULICIFOILIA
EXCAVATION
SITE BOUNDARY
EXISTING FENCELINE
CONTOUR (MAJOR) 25
CONTOUR (MINOR) 30
WATERWAY
BASSLINK EASEMENT
SHORING / SHEETPILING

LEGEND

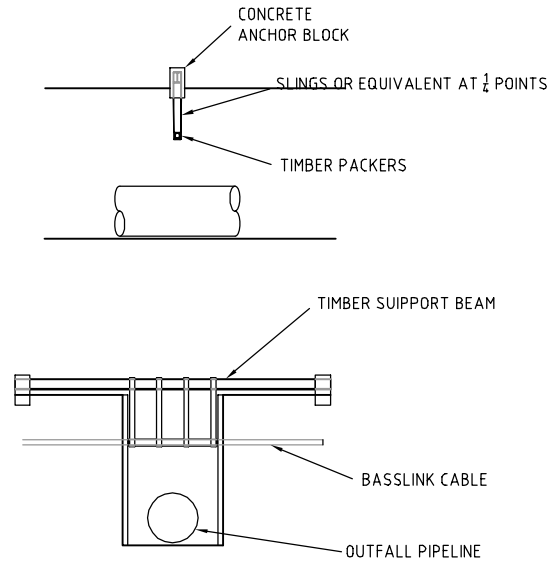


PLAN
1:750



NATURAL SURFACE	25.93	30.757	29.399	26
DEPTH	-2.83	-3.051	-4.678	-2.154
PIPELINE	23.1	27.706	24.721	23.846
CHAINAGE	500	550	600	650

SECTION
H 1:750
V 1:37.5



DETAIL OF BASSLINK CROSSING

ACKNOWLEDGEMENTS:

BASE DATA SUPPLIED BY THE LIST - www.thelist.tas.gov.au
CONTOUR DATA SUPPLIED BY HYDRO TASMANIA, SURVEY & GEOGRAPHIC INFORMATION SYSTEMS

VEGETATED COMMUNITY & THREATENED SPECIES INFORMATION BASED ON GHD PLAN 3116482 DATED 2/12/05, RESPECTIVELY.

ATTERIS
ATTERIS PTY LTD
LEVEL 6, 68 ST GEORGE TCE
PERTH WA 6000
PO BOX 7305
CLOISTERS SQUARE WA 6850

DRAWING No	REFERENCE DRAWINGS	REV No	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	APPROVED	CLIENT
		0	7/12/05	ISSUED FOR APPROVAL	DRC	EJ	EJ	
		A		ISSUED FOR COMMENTS	DRC	EJ	EJ	

CLIENT: Gunns LIMITED

DRAWN: D.CAMPBELL DATE: 7/12/05
CHECKED: E.JAS DATE: 7/12/05
APPROVED: E.JAS DATE: 7/12/05
CLIENT: DATE:

BELL BAY PULP MILL
ONSHORE PIPELINE
TUNNEL CONCEPT UNDER DUNE

SCALE: AS SHOWN | A3 | DWG No 05-003-D-005 | REV 0

Attachment 5

Construction Method Cartoon

VIRGIN SHORELINE

PIPE STRING FABRICATION

HYDRAULIC EXCAVATOR

TRENCH EXCAVATION / DREDGING

PONTOON MOUNTED
HYDRAULIC EXCAVATOR

EXCAVATED TRENCH

PIPE ROLLERS

PIPELINE

PULLING HEAD

PIPELINE TOWOUT

PULL WIRE

WINCH PONTOON

EXCAVATED TRENCH

ANCHOR

ANCHOR

HYDRAULIC EXCAVATOR

PIPELINE

TRENCH BACKFILL

PONTOON MOUNTED
HYDRAULIC EXCAVATOR

ROCK SUPPLY VESSEL

ATTERIS

TYPICAL PIPELINE SHORE CROSSING CONSTRUCTION
(OPEN CUT)

E. JAS 15/06/05