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Summary Environmental Plan Supplement

Rig 175 Platform Based Drilling Program
Synthetic Based Mud Use

Introduction

The Bass Strait Environmental Plan covers the offshore production activities of Esso Australia Resources Pty Ltd (EARPL) and BHP Billiton Petroleum (Bass Strait) Pty Ltd (BHPB) within the Gippsland Basin in Bass Strait. This is a summary of the Environmental Plan Supplement to the Existing Bass Strait Environmental Plan (2004), prepared by Esso Australia Pty Ltd (Esso) on behalf of EARPL and BHPB for the Rig 175 Drilling Program, incorporating the use of synthetic based drilling muds (SBMs). This Environmental Plan Supplement was approved by the Department of Primary Industries on the 19th December 2006.

Esso on behalf of EARPL and BHPB plans to undertake a platform based drilling program using Rig 175. This program is expected to involve drilling seven wells at Fortescue (FTA) and four wells at Snapper (SNA) during a 12-month program (Figure 1). There is the potential for this program to be extended beyond this based on the results of the drilling program and as such, additional wells and additional platforms are included as part of this Environmental Plan Supplement. The platform based drilling program will use synthetic based muds (SBMs) to drill the extended reach sections of the wells to reach outlying oil and gas reserves.

Description of the Activity

Drilling Muds

Drilling fluids or muds are made up of a base fluid (water or a synthetic compound), weighting agents (most frequently barium sulfate (barite)), bentonite clay to help remove cuttings from the well and to form a filter cake on the walls of the hole, lignosulfonates and lignites to keep the mud in a fluid state, and various additives that serve specific functions. Drilling muds with diesel, or mineral oil base fluid are not used in Bass Strait, and historically, have not been used in Australia.

Drilling muds have a number of important functions and it is the function that determines the chemical composition and density of the mud. The main functions are:

- Removal of cuttings from the face of the wellbore.
- Control the influx of gases or liquids into the wellbore.
- Provision of pressure stability/counterbalance the formation pressure.
- Chemical stability.
- Heat dissipation.
- Elimination of water contact with the formations, which can cause chemical reactions.
- Prevention of plugging of natural formation porosities to maintain oil and gas productivity.
- pH balance and corrosion inhibition to protect drilling bits and metal casing.
- Ability to log and analyse cuttings while drilling.

Esso's standard drilling fluid in Bass Strait is a water based mud (WBM) and is composed mainly of seawater with added compounds such as barite (barium sulphate mineral), a weighting agent, and other additives for specific functions.

However, to maintain wellbore stability and manage high frictional forces involved in the drilling of long reach high-angle open-hole sections, a non-water based drilling mud is required as it provides greater inhibition and lubricating properties which enable the difficult sections to be drilled successfully.

The use of SBMs can also result in faster drilling rates, reduction of remedial work in the event of unscheduled 'downtime' events such as weather, and reduced waste generation as sidewall washout is reduced and SBM can be reused for a longer period of time and requires less chemical treatment than water based muds.

Drilling Mud Recovery and Cuttings Drying

Muds are treated to remove formation solids and are then recycled and recovered while drilling. Crushed rock cuttings from the hole are separated from the muds by vibrating screens (shale shakers) and to a lesser extent, by the de-sander and de-silter, which remove the sand and silt from the mud. Additional SBM is recovered as a cuttings dryer system and centrifuge is used to process the cuttings prior to discharge and return the mud back to the active mud system.

Drilled cuttings will be continuously discharged overboard after separation from the mud by the shale shakers. To minimize the retention of synthetic fluid on cuttings and allow the additional recovery of valuable drilling fluid, a cuttings dryer system and centrifuge will be used to process the cuttings and mud. Following treatment with the cuttings dryer and the centrifuge, the synthetic fluid retained on cuttings (ROC) should be less than 10%. In the unlikely event the cuttings dryer system is not available (for example, in the event of equipment failure), the drilled cuttings will be continuously discharged overboard after separation from the mud by the shale shakers for a minimal amount of time until the cuttings dryer system is fully operational.

At the completion of a drilling program, used SBMs are returned to shore for reconditioning and future use. This maximises recycling and eliminates the need for bulk discharge. Discharges of SBMs into Bass Strait are thus confined to material adhering to the surfaces of the cuttings.

The Environment

Fortescue, Snapper and the other Gippsland Basin Joint Venture production platforms are located in Bass Strait.

Weather

Wind speeds are typically in the range of 10–30 km/hr, with maximum gusts reaching 100 km/hr. Summer air temperatures in coastal Victoria range from early morning lows of 12–15°C to afternoon highs of 22–24°C. Equivalent winter ranges are 6°C rising to 12–15°C in the afternoons.

Sedimentation

Sedimentation is generally low due to the small supply from rivers and the relatively low productivity of carbonate. Sedimentation rates are estimated at 50–160 mm per 100 years. In the Gippsland Basin, seabed material is predominantly calcium carbonate comprised of calcarenite marls and marine shales.

Oceanography

Tides and wind stress contribute to currents within Bass Strait. In the open waters, tides generally result in elliptical movement of water particles, predominantly in a northeast–southwest orientation. Wind-driven currents in eastern Bass Strait tend to be constrained by local topography and usually run parallel with the coast along a northeast to southwest axis.

Waters of Bass Strait are generally well mixed but surface warming sometimes causes weak stratification in calm summer conditions.

Temperatures in the subsurface waters of central Bass Strait range from about 13°C in August/September to 16°C in February/March. Surface temperatures in eastern Bass Strait can exceed 20°C at times in late summer due to the warmer waters of

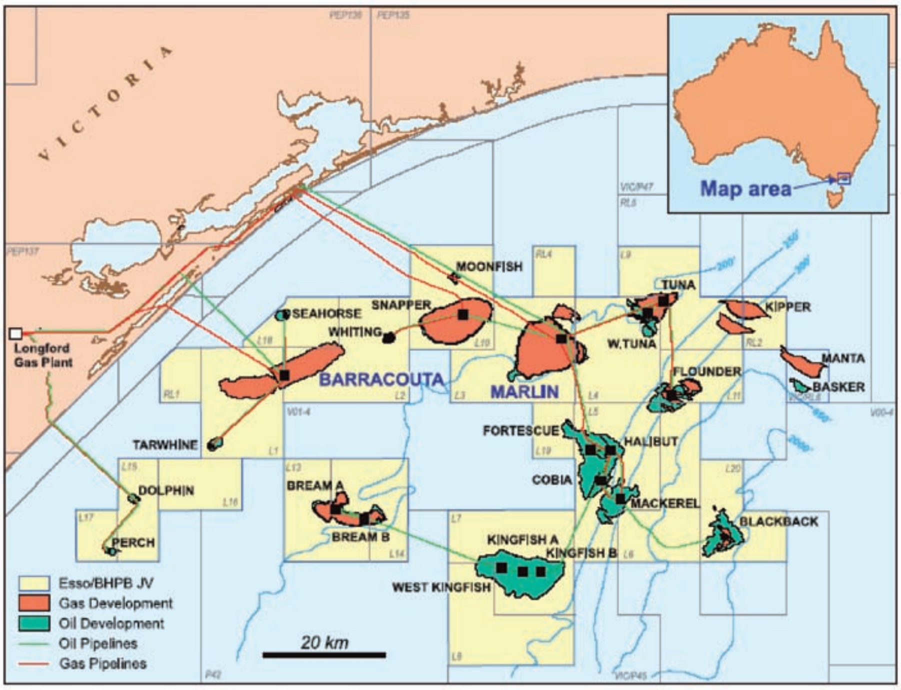

Figure 1. **Regional map of the Gippsland Basin, and position of EARPL-operated producing fields.**

the East Australia Current entering the strait.

Bass Strait is a high-energy environment exposed to frequent storms and significant wave heights. Storms may occur several times a month resulting in wave heights of 3 to 4 metres or more.

Biological Environment

Bass Strait is an area of high faunal diversity and species endemicity. This is largely due to the fact that the area has been isolated in geological time and by climatic barriers, with a history of variable exposure and immersion during sea-level changes in the last few million years.

Bass Strait also contains a number of species of high commercial and conservation value as follows:

Zooplankton - Plankton species are a key component in oceanic food chains. More than 170 species of zooplankton have been recorded in eastern and central Bass Strait, with copepods making up approximately half of the species encountered.

Benthic Invertebrates - Bass Strait has a high diversity of a wide range of invertebrate groups compared with equivalent areas of the northern hemisphere. Crustaceans and polychaetes dominate the infaunal communities, many of which are unknown species. Many species are widely distributed across the strait, suggesting heterogeneous sediments and many microhabitats. Some invertebrate groups are allied with fauna from Antarctic seas. In winter, when the east coast of Tasmania is supplied with water from the sub-Antarctic, the overlap with the East Australia Current contributes to the high diversity.

Fish and Shellfish - It is estimated that there are over 500 species of fish found in the waters of Bass Strait, including a number of species of importance to commercial and recreational fisheries.

Description of Drilling Mud

The proposed SBM drilling fluid is referred to as an Accolade system and comprises of an Ester (Petrofree) and IO/LAO blend. Petrofree has been used in Bass Strait during previous drilling programs. A description of the Accolade system is presented in the table below.

Table 1 **Composition of Accolade Drilling Fluid**

	Accolade Products	**Volume %**
Base Fluid	Synthetic Olefin	41.7
	Esther	17.8
Brine Phase	CaCl2 Brine	35.99
Emulsifier	Emulsifier	3.09
Alkalinity	Lime	0.25
Fluid Loss Control	Polymer	0.55
Viscosifier	Tall Oil Fatty Acid	0.62

No component of Accolade drilling fluid has been found to have carcinogenic, mutagenic, reproductive, or teratogenic effects at levels greater than 0.1%. Ecological effects are minimised as the drilling fluid has a low water solubility and is not likely to move rapidly via water flow.

Because Accolade is a clay-free SBM, it has unique drilling performance benefits such as reduced downhole mud losses and pump pressures, improved rheological responsiveness and suspension characteristics, increased tolerance to contamination, fewer products and less inventory required than with conventional drilling muds.

Historic Examples of Synthetic-Based Mud Use

The use of SBMs has been prevalent around the world for the past 15 years. The largest area of activity has been in the Gulf of Mexico in which over 100 wells are drilled every year. Due to the drilling and environmental advantages of SBMs over WBMs and oil based muds (OBMs), industry has experienced an increase in the number of offshore wells drilled with SBM.

The use of IO (component of Accolade base fluid) has also been prevalent in Australia, Gulf of Mexico, Nigeria, UK, China, Indonesia, and Eastern Canada. The use of LAO (component of Accolade base fluid) is prevalent in Norway, Australia, UK, Angola, Venezuela, Gulf of Mexico, USA, Caspian, Nigeria.

Esso has previously used SBMs (Petrofree) at a number of locations around Australia, including: Fortescue (1995–1996), Snapper (late 1990s), Blackback (1999), Flounder and Bream-B (2005).

Polymerised olefins (IO and LAO) have been used in both offshore Western Australia and Victoria at Jansz (Mobil Exploration and Producing Australia Pty Ltd), Agincourt/Gibson (Apache) and Otway Gas (Woodside).

Environmental Impacts

SBMs have been designed to be less toxic and to biodegrade faster in marine sediments than OBMs. While providing the performance of OBMs since the introduction of SBMs, there has been extensive laboratory testing and field monitoring of the environmental performance of SBMs.

Discharged Cuttings Behaviour
Discharges of cuttings and drilling mud to the ocean arise from the continuous discharge from the shale shakers and cuttings dryers during drilling (predominantly cuttings and adhered mud). Drill cuttings are generally inert and are expected to have limited impact on benthic fauna and flora, apart from the physical smothering and possible sediment grain size alterations. The physical effects of the discharged cuttings will have a minimal effect on the benthos in the long term.
Not all the drilling fluid can be removed and a coating of residual drilling fluid remains attached to the cuttings. This residual coating of drilling fluid enters the marine environment when cuttings are discharged over the side of the drilling rig into the ocean. Whilst the discharge of bulk WBMs sometimes occurs at the end of drilling, SBMs are not discharged but are returned to the manufacturer for reconditioning.

Initial Seabed Deposition - Drilling muds and cuttings are composed primarily of insoluble base fluid and heavy solids that settle rapidly. The highest concentration of SBM is usually located in sediments within 100 m from the platform. When discharged to the ocean, SBM and cuttings tend to clump together in discrete masses that settle rapidly to the bottom. Water cannot easily penetrate the oleophyllic mass of cuttings, so they do not disperse efficiently. The greatest impact resulting from the discharge of drilling muds and cuttings is on the benthos. Mud and mud-coated cuttings can directly bury the benthos, make sediments anaerobic and increase turbidity, sediment toxicity and organic load.

Modelling of Cuttings Behaviour - Modelling investigations have shown that under Bass Strait conditions, drilling mud disperses over an extensive area and periodic storm events prevent build-up of piles of cuttings. Underwater video photography of the seabed around the Fortescue platform taken in 1993 and 1996 has also confirmed the absence of accumulated piles of cuttings beneath the discharge and the limited extent of visibly evident SBM from the platform.

Water Column Impacts
Since SBMs are insoluble and also settle rapidly to the sea floor when present only as a coating of the cuttings, they do not disperse into the water column and do not increase water column turbidity significantly compared with WBMs. Concentrations of base fluid in solution in the water column are considered unlikely to exceed 1 mg/l at any time during cuttings discharge.

The impacts to the water column from discharging SBM cuttings are considered to be negligible due to the following:

- Low solubility of NABF in seawater.
- Low water column dispersion and residence time due to rapid settling rate.
- Drilling discharges are intermittent, transient and limited to SBM adhered to cuttings.

Benthic Impacts
The discharges of all cuttings and adhered drilling muds has the potential to impact benthic habitats and the benthic organisms by processes of physical smothering and the effects of organic enrichment, regardless of the type and toxicity characteristics of the particular SBM used.

The initial deposition of cuttings can also have a physical impact on bottom-dwelling animals by altering the sediment particle size distribution of the substrate. Since SBMs are biodegradable organic compounds, their presence with the cuttings on sediments increases the oxygen demand in the sediments. This organic enrichment of the sediment, can lead to anoxic/anaerobic conditions as biodegradation of the organic material occurs. Anoxic conditions may also result from burial of organic matter by sediment redistribution.

Physical Persistence
The duration of impacts to the benthic community is related to the persistence of SBM cuttings accumulations and associated hydrocarbons in the sediment.

Cuttings generally settle in a very heterogeneous pattern on the seabed and are expected to be less persistent in areas with thinner deposits, with recovery from any impacts expected to be more rapid than areas with deep piles. Cuttings piles seldom occur in deep water, or in high energy environments, which is consistent with Esso's observations in Bass Strait.

Field studies indicate that for SBM cuttings discharges, the areas that recovered most rapidly were those characterised by higher energy seabed conditions, such as in Bass Strait. Because of the tendency for adhesion between SBM cuttings, re-suspension of SBM cuttings requires higher current velocities than those required for WBM cuttings.

Bioaccumulation
Bioaccumulation of pollutants, such as of non-polar organic compounds, occurs when organisms incorporate those compounds within their biomass with an increase in the concentration over time, compared to the chemical's concentration in the environment. The extent of bioaccumulation is a function of the ability of the compound to enter tissues (bioavailability) countered by the ability of the organism to depurate or metabolise the compound.

Studies of the bioavailability of contaminants (mainly metals and hydrocarbons) in drilling muds generally indicate low risks. Metals in particulate form accumulated by marine animals usually remain associated with the digestive tract and do not accumulate in muscle tissues. Metals associated with drilling fluid have a limited bioavailability to marine organisms and that accumulation to levels harmful to humans is extremely unlikely. The potential for significant bioaccumulation of SBMs in aquatic species is believed to be low.

Biodegradation
SBMs have been developed to biodegrade much more rapidly than the early generation oil or mineral oil based muds. Organic compounds in the sediment, whether SBM, or settled biomass such as algae and other detrital material, will biodegrade by the actions of the naturally occurring microorganisms.

Aerobic biodegration conditions occur at the exposed surface and margins of the cuttings accumulations.

Anaerobic biodegration would be expected to occur deeper within the cuttings accumulation or impacted sediment. Where anoxic conditions are generated, additional anaerobic biodegradation may occur by specific populations of microorganisms.

The effects of SBM biodegradation in sediments is typical of smothering and organic enrichment generally leading to conditions of reduced oxygen or anoxia in the affected sediments: water column interface. As a result of these factors, benthic macro- and meio-fauna populations may be altered in the affected sediments. Typically, benthic diversity is reduced and abundances of organisms tolerant of reduced oxygen increase, until the SBM has been sufficiently removed to mitigate the organic enrichment and organisms can recolonise the sediments.

Field Surveys and Monitoring
A number of field monitoring studies to assess seabed impacts of drilling discharges have been completed within Bass Strait and around the world. The impacts from the discharge of SBM cuttings are described in the literature with consistency across all geographical locations and depths where monitoring has occurred, and with little if any significant deviation with differences in base fluids or blends of SBM actually used. While the recovery of the benthic communities is dependent upon the type of community affected, the thickness, area extent and persistence of the cuttings (due to a combination of seafloor redistribution and biodegradation), and the availability of colonising organisms, degradation of SBM and the recovery of benthic diversity is substantially advanced one year after cessation of drilling.

Given this uniformity of observation, it seems most likely that smothering and organic enrichment during the biodegradation of SBMs are the primary causes of the observed impacts, regardless of any toxicity effects. Where concentrations of SBM may be high enough to cause some toxic effect, such concentrations only occur at the closest point to the discharge, and mainly during discharge, when impacts of smothering and organic enrichment would also be highest.

The impacts of the discharge of SBM cuttings is well understood. In the case of the high energy environment of Bass Strait into which the cuttings will be discharged, impacts to the seabed and benthic communities will be limited to <200 metres from the platform, and will recover to similar conditions within 12 months from completion of drilling.

Environmental Risk Assessment and Management

Risk Assessment

A comprehensive risk assessment was conducted. Existing safeguards and additional controls for management of the risk were identified.

Table 5 **Environmental risk assessment**

Activity and Potential Impacts	Safeguards / Management
Drill cuttings discharged to seabed could smother benthic organisms on seabed	• Dispersion of cuttings through a range of 40-400 m of water column does not create a cuttings pile around the Bass Strait platform due to high wave energy dispersion.
Discharge of drilling muds adhered to cuttings could impact water quality and planktonic	• The drilling fluids are insoluble and sink rapidly, such that risks of adverse impacts to water column organisms during descent water column organisms is minimal. • Use SBM and biodegradable drilling fluids as first choice. • Recovery of synthetic-based drilling fluids with use of shale shakers and cuttings dryer system. Minimise discharge to that adhered to cuttings. Low concentrations of any suspended particulate phase.
Discharge of drilling muds adhered to cuttings could impact seabed quality and sessile benthic organisms organisms in the immediate vicinity of the settled SBM cuttings until they disperse or degrade.	• The drilling fluids are comprised of compounds with extremely low toxicity, have no long lasting effect on benthic communities. Short term effects on diversity and abundance are with extremely low toxicity, have no long restricted to <200 m from the platforms in Bass Strait. • Use SBM and biodegradable drilling fluids as first choice. • Recovery of synthetic-based drilling fluids with use of shale shakers and cuttings dryer system. Minimise discharge to that adhered to cuttings. Low concentrations of any suspended particulate phase
Spills of drilling muds to ocean could impact water quality and planktonic organisms in the water column during descent.	• Ensure management place an emphasis on spill elimination. • Ensure all relevant personnel and contractors are appropriately trained in spill management. • Ensure that the transport of SBM to and from the platform is carried out in the shortest and safest time possible. • Carry out SBM transfer out of extreme weather periods. • Ensure that all necessary spill equipment is functional and accessible.

The potential impacts arising from the discharge of drill cuttings coated with small quantities of synthetic-based drilling fluids are expected to be highly localised and transient, which has been confirmed by a number of past studies. These impacts can be summarised as follows:

- Primary: Smothering and organic enrichment.
- Secondary: Toxicity.

Risk analysis identifies the environmental risk associated with using SBMs and its impact to environment as low.

Implementation Strategy

To ensure that the environmental performance objectives and standards in the Environment Plan & Supplement are met, an implementation strategy has been developed which includes:

- Identification of key environmental roles and responsibilities
- Induction training of all personnel including environmental awareness and requirements for correct disposal of wastes
- Spill prevention
- Monitoring of drilling fluid concentrations and volumes and volume of drilling cuttings produced
- An environmental compliance audit
- Reporting of any environmental incidents or spills

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