Kingborough Council

Development Plan and Environmental Management Plan for Blackmans Bay Outfall Extension

Consulting Environmental Engineers
DEVELOPMENT PLAN AND ENVIRONMENTAL MANAGEMENT PLAN
FOR BLACKMANS BAY OUTFALL EXTENSION

Foreword

This Development Proposal and Environmental Management Plan (DPEMP) supports the application by Kingborough Council to replace the existing short outfall at Blackmans Bay with a long outfall. The proposal does not include any change in the quality of effluent discharged, which will continue to be disinfected effluent from the Blackmans Bay wastewater treatment plant (WWTP).

The existing outfall extends only 15 m from the shore and was constructed about 30 years ago. The offshore section has broken due to corrosion and the forces of waves and entrained air.

The Kingborough Council proposes to replace the existing outfall with a 600 m long outfall. The long outfall will connect to the existing pipeline that extends down the cliff face, be buried to about the 4 m depth contour and extend on the seabed further offshore to an 80 m long diffuser at 13 to 14 m depth.

The purpose of the DPEMP is to provide the information needed for individuals and groups to gain an understanding of the proposal and provide informed comments to planning agencies. The DPEMP describes the proposal, the need for the proposal, the alternatives, the existing environment, the effects that may occur and the measures proposed to minimise any adverse effects. A key benefit of the proposal is that the long outfall will have a smaller environmental impact than the existing outfall.

The DPEMP is a part of the Development Application to construct the replacement outfall. It is readily available to the community and copies are provided to all referral authorities with responsibility to assess the proposal.

Questions, comments and submissions from the community are encouraged. Any questions or requests for additional information should be sent to:

Jon Doole,
Environmental Coordinator
Kingborough Council

The period for public review is shown on the web site of Kingborough Council. Submissions on the proposal to replace the Kingborough outfall should be forwarded to:

Planning Section
Kingborough Council
Kingborough Civic Centre
15 Channel Highway
Kingston TAS 7050
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EXECUTIVE SUMMARY

The Proposal

The proposal by Kingborough Council is to replace the existing outfall at Blackmans Bay with a new long outfall extending 600 m offshore, including an 80 m long multi-port diffuser. The proposal does not involve any change in the quality of effluent discharged, which will continue to be disinfected effluent from the Blackmans Bay wastewater treatment plant (WWTP).

Alternatives

The alternatives considered were:
1. Reuse of effluent on land (only partial reuse is feasible and an outfall is still needed for the remainder of the effluent);
2. Improved treatment (an upgrade of the treatment plan is planned, but this will not eliminate the need for the outfall); and
3. Do nothing (will not meet the environmental sustainability objectives of the Council or the State Government).

Purpose of Outfall and Diffuser

The purpose of the outfall and diffuser is to minimise environmental effects on marine biota or public health. This is best achieved by discharging the effluent away from shore and at sufficient depth to achieve a high initial dilution. A high dilution is necessary to prevent adverse effects from fresh water effluent and nutrients on marine biota in the vicinity of the discharge.

The existing outfall discharges through an open-ended pipe at a depth of 1.5 m below mean sea level. As a result, the initial dilution (the dilution achieved due to the momentum and buoyancy of the discharge) is only 4:1. Monitoring studies have found that there are adverse local effects in the zone in which the initial dilution is consistently less than 50:1 due to the effects of the fresh water discharge, and elevated levels of nutrients and ammonia. The adverse environmental effects resulting from low dilution will be eliminated by constructing a long outfall with a diffuser that achieves a high initial dilution.

The proposed long outfall and diffuser will achieve an initial dilution of 200:1 at the current discharge rate of 4.1 ML/d and 130:1 at the projected long term future discharge of 8 ML/d. These predicted dilutions are greater than those observed in field studies to have no effect on marine biota. The effluent field will not be visible, even during calm conditions.

In summary, the long outfall will provide a substantial improvement on the initial dilution achieved by the existing outlet, which is only 4:1. The toxicity and other adverse environmental effects resulting from the low dilution of the existing outlet will be eliminated.
Blackmans Bay Treatment Plant

The replacement outfall will discharge disinfected secondary effluent from the Blackmans Bay treatment plant which currently has an average flow of 4.1 ML/d. The average flow is expected to increase to 8 ML/d as the population of Kingborough increases. As part of the Kingborough Sewerage Strategy, it is proposed to upgrade the Blackmans Bay treatment plant and further improve the effluent quality so that the effluent meets more stringent DPIWE guidelines for discharges to marine waters (DPIWE, 2004).

Environmental Context

The existing outfall comprises a pipeline extending down the cliff from the centre of the plant and across the rocks at the base of the cliff. The point of discharge is only about 15 m from shore and 1.5 m below mean sea level. The outfall is on a rocky coast at the base of a steep cliff with a narrow beach and difficult public access.

The existing Blackmans Bay outfall is on the western shore of the lower Derwent Estuary. The Derwent Estuary has a well-formed saline water circulation with fresh and brackish water flowing out to sea in the upper layer and a net inward flow of seawater in the lower layer.

The Derwent River is the major source of fresh water to the estuary, with an annual average discharge rate of 90 m$^3$/s. Other tributaries contribute about 1 m$^3$/s on average. The discharge from the Blackmans Bay plant (currently 4.1 ML/d) is only 0.05 per cent of the total fresh water input to the estuary.

Thus, while there is a localised environmental effect near the end of the outfall due to the discharge of fresh water and nutrients, the discharge does not have a significant influence on the currents or salinity distribution in the estuary. The future multi-port diffuser on the long outfall at Blackmans Bay will produce a high initial dilution and eliminate any future adverse effect of the freshwater input from the discharge.

The key components of the marine biological community near the Blackmans bay outfall are:
• Giant string kelp (Macrocystis pyrifera);
• Common kelp (Ecklonia radiata);
• Foliose red seaweeds - predominantly Plocamium species;
• Coralline encrusting algae - flat coral-like pink algae that form a paint-like crust on rocks; and
• Encrusting red algae - predominantly Feldmania (a dark red to purple coloured alga that forms a leathery crust on rocks).

Giant string kelp requires nitrogen-rich water in a well mixed marine environment and, in Tasmania, giant string kelp is most abundant on the south-east coastline. The forest of giant string kelp in Blackmans Bay is the largest and most luxuriant in the Derwent Estuary. The health of the string kelp is supported by a supply of nutrients from the existing outfall.
Potential Effects and Their Management

The key issues identified by the Department of Environment, Parks, Heritage and the Arts (DEPHA) for consideration in relation to the proposal are the principal focus of the DPEMP; these are aquatic biota, recreation, public health, geomorphology and public amenity.

Studies have shown that the long outfall will achieve a much higher dilution and hence reverse the local impacts on aquatic flora and fauna that the existing outfall has caused.

To maintain the supply of nutrients to the string kelp, three small discharge ports have been included in the long outfall to allow a small (and variable) quantity of effluent containing nutrients to be discharged near the offshore edge of the string kelp forest. The discharge rate can be adjusted by changing the size of the plug in the port nozzles (a full plug would ensure zero discharge if that was considered to be the best long term arrangement).

The beach above the outfall is narrow and is at the base of a steep cliff below the fenced site of the treatment plant. It is essentially covered by water at times of high tides and storms and difficult to access from land. The main use of the beach is by surfers who use the outfall as a passage through the rocks to reach the water.

The recent health risk assessment identified the problems of direct contact of surfers with the effluent, even though it has been disinfected (CEE, 2007). This primary contact will cease when the discharge is 600 m offshore.

A search of significant local geomorphology sites was undertaken, and the proposal will not affect any of them. The cliff and rocky beach of Blackmans Bay are significant local landforms and the outfall construction method has been devised to minimise any changes in the appearance or public use of the area.

Monitoring Program

A marine biological monitoring program will be carried out, with a baseline study already completed and further surveys at six monthly intervals for the first three years of operation. The marine biological monitoring program will:

- Monitor effluent quality;
- Monitor the effect of the effluent discharge on infaunal communities in the vicinity of the proposed diffuser location;
- Monitor any changes in Macrocystis abundance and associated community condition due to reduction in nitrogen loads into the embayment;
- Indicate when it is appropriate to adjust the three ports near the kelp to optimise the supply of nutrients to the kelp; and
- Monitor the recovery of algae and associated species near the existing outfall.
Conclusion

The specific approvals required for the proposal to proceed are:

- Planning approval;
- Lease from Crown Lands; and
- Modified Discharge Licence from DEPHA – to permit discharge through the long outfall rather than the existing outfall.

The proposal does not introduce any new outfall into the Derwent Estuary. Instead, an existing outfall that has a local environmental impact will be replaced by a long outfall that achieves a much greater initial dilution (more than 100:1) and negligible local impact. The diffuser has been designed so that there will be no adverse effects of the discharge on marine life and the effluent field will not be visible, even during calm conditions.

There will be no increase in discharge of effluent as a result of the long outfall. The existing above-ground pipeline down the cliff face will be retained and continue to be used. The long outfall will include three ports that can be adjusted to achieve the optimum addition of nutrients to maintain the health of the string kelp that grows prolifically in Blackmans Bay.

The proposed outfall will be buried across the shore line and to a distance of about 30 m from shore, and hence will not be visible. The trench will be backfilled with local natural materials to make the appearance the same as existing conditions. The proposal will improve the public health situation for the few surfers that use the existing outfall to enter the sea. The long outfall will not have any effect on recreational use of the estuary or fishing.

Based on the conclusions of the Environmental Risk Assessment, the proposed discharge is considered to be sustainable.
DEVELOPMENT PLAN AND ENVIRONMENTAL MANAGEMENT PLAN
FOR BLACKMANS BAY OUTFALL EXTENSION

1 INTRODUCTION

Title of Proposal
Blackmans Bay Outfall Extension

Proponent
Kingborough Council
Kingborough Civic Centre
15 Channel Highway
Kingston TAS 7050

1.1 Description of Proposal

The proposal is to replace the existing 15 m long outfall at Blackmans Bay with an outfall extending 600 m offshore, including an 80 m long multi-port diffuser. The proposal does not involve any change in the volume or quality of effluent discharged, which will continue to be disinfected secondary effluent from the Blackmans Bay wastewater treatment plant (WWTP).

The existing outfall was constructed about 30 years ago. The offshore section has broken due to corrosion and the forces of waves and entrained air. Because the discharge is in shallow water with no diffuser, there is little immediate dilution. Marine biological studies (see discussion later in this DPEMP) have demonstrated that there is a local impact zone around the outlet due to the low dilution.

The Kingborough Council proposes to replace the existing outfall with a 600 m long outfall. The long outfall will produce a minimum initial dilution of 100:1 or more, which is sufficient to ensure there will not be adverse effects on marine life arising from the effluent discharge.

1.2 Stakeholder Consultation

In developing the proposal, stakeholder consultation has been undertaken as follows.

- The report on the Environmental Risk Assessment for the wastewater treatment and effluent discharge arrangements at Blackmans Bay and Taroona was released to the public in May 2006;
- The Kingborough Council has discussed the extension of the Blackmans Bay outfall in several Council meetings held in 2006/07. Minutes of the meetings are available to all residents. The Kingborough sewerage strategy, which included the outfall extension, was adopted by the Council in March 2008.
- Prior to the submission of the Planning Development Application, a summary of the Environmental Risk Assessment and Long Term Sewerage Strategy was provided on the Kingborough Council website;
- Newsletters are sent out two or three times a year to local residents. Discussions about the upgrade of the Blackmans Bay treatment plant and the long outfall have been held regularly with residents living close to the plant. Several articles on the sewerage strategy and the outfall extension have been published in “Kingborough News”
- Reports on *Environmental Risk Assessment, Kingborough Long Term Sewerage Strategy and Marine Biological Studies* are available on Council website;
- Consultation with government agencies;
- Public Meeting held on 18 February 2008 with residents from around the treatment plant area invited to review and discuss the proposals.

The results of public consultation to date are that the local community appreciate the need to replace the existing outfall. There is support to provide a high level of treatment so that only a high quality effluent is discharged and to achieve reuse of the effluent where it is feasible to do so.

The Planning Development Application and DPEMP will be advertised in local newspapers with a reference to the Council website to allow widespread consultation on the proposal.

**1.3 Environmental Standards and Guidelines**

The proposal has been designed taking account of the relevant Commonwealth, Stage and local government policies, strategies and management plans, including:
- Aboriginal Relics Act 1975
- Australian and New Zealand Guidelines on Fresh and Marine Water Quality 2000
- Environmental Management and Pollution Control Act 1994
- Environmental Management and Pollution Control (Waste Management) Regulations 2000
- Environmental Management and Pollution Control (Miscellaneous Noise) Regulations 2004
- Environmental Protection and Biodiversity Conservation Act 1999 (Cth)
- Living Marine Resources Management Act 1995
- State Policy on Water Quality Management 1997
- Tasmanian State Coastal Policy 1996
- Threatened Species Protection Act 1995
- Water Management Act 1999

**1.4 Other Related Proposals**

The replacement of the Blackmans Bay outfall is a component of the Kingborough Sewerage Strategy, which includes upgrading treatment plants and effluent quality, phasing out effluent discharge to North West Bay, upgrading the outfalls at Blackmans Bay and Taroona, and encouraging reuse of effluent. A DPEMP for each major component will be prepared as the strategy unfolds over the next 20 years.
1.5 Specific Approvals Required

The specific approvals required for the proposal to proceed are:

- Planning approval – issued by Kingborough Council after submissions from all referral agencies – and review of the DPEMP coordinated by Department of Environment, Arts, Heritage and the Arts (DEPHA);
- Lease from Crown Lands – to permit construction of the connection structure and the replacement section of the outfall across the foreshore;
- Modified Discharge Licence from DEPHA – to permit discharge through the long outfall rather than the existing outfall.

The approvals are likely to be issued with conditions, including the requirement to meet all commitments in the DPEMP during design, construction and commissioning of the replacement outfall, and any additional conditions as a result of community and agency review of the DPEMP and associated documentation and reports.

A risk assessment has been carried out in accordance with the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 and it was determined that the proposal is not a controlled action under that legislation, as it does not trigger any of the provisions of a controlled action. Thus the assessment and decisions on approvals will be made by Tasmanian agencies, coordinated by DEPHA.
2 PROPOSAL DESCRIPTION

2.1 Proposal Outline

The proposal is to replace the existing 15 m long outfall at Blackmans Bay with a 600 m pipeline extending offshore to deeper water beyond the string kelp forest and including an 80 m long multi-port diffuser.

The existing outfall comprises a pipeline extending from the Blackmans Bay WWTP down the face of the cliff to the beach, and a pipeline about 15 m long in a trench excavated across the rock. The discharge is from the open end of the pipe at a depth of about 1.5 m (below mean sea level).

The existing above-ground pipeline down the cliff face will be retained and continue to be used. A connection and de-aeration chamber will be constructed at the base of the cliff to transfer the flow from the existing cliff face pipeline to the long outfall, and to remove air.

The details of the proposed project are shown in the attached drawings:

Appendix 1 DR-061105-001 New Blackmans Bay Outfall – Plan and Elevation
Appendix 2 DR-061105-002 New Blackmans Bay Outfall – Sections and Details
Appendix 3 DR-061105-003 New Blackmans Bay Outfall – Diffuser Section
Appendix 4 DR-061105-003 New Blackmans Bay Outfall – De-aeration Chamber

At and near the shore, the long outfall will be buried in a trench that extends about 30 m offshore from the chamber. The new pipeline will be concreted into the trench and then the trench will be backfilled with rock and concrete. The top of the trench will be faced with natural rock to match the existing conditions as closely as possible, with the intention of making the filled trench visually indiscernible. A small amount of controlled blasting will be necessary to excavate the foundation for the chamber and the 30 m long trench.

The rest of the long outfall will be a 500 mm diameter high density polyethylene (HDPE) pipe located on the seafloor. From Chainage 30 m to about 200 m, the long outfall will be secured with concrete blocks or strapped to the underlying rock as shown in Drawing 002 (Section A). There will be minor trimming of rock in this section to allow the pipeline to follow a graded alignment.

There is an important string kelp forest (*Macrocystis pyrifera*) in this area and the pipeline materials and method of installation have been selected to cause as little disturbance to the string kelp as possible.

The health of the string kelp is supported by a supply of nutrients from the existing outfall. To maintain this condition, three small discharge ports have been included in the long outfall at Chainages 145 m, 170 m and 195 m to allow a small (and variable) quantity of effluent containing nutrients to be discharged near the offshore edge of the string kelp forest. The discharge rate can be adjusted by changing the size of the plug in the port nozzles (down to zero discharge if that was considered to be the best long term arrangement).
After construction, the total area covered by permanent facilities will be 5 m$^2$ for the connection chamber and 300 m$^2$ for the pipeline. A 10 m wide corridor may be used for construction, so the total area involved in construction is approximately 0.7 ha.

**Design Issues**

The long outfall has been designed with sufficient hydraulic capacity to handle the future peak wet weather discharge after allowing for sea level rise. It also can operated satisfactorily with lower flows should a high proportion of effluent be reclaimed in the future.

There will not be any construction on the cliff, but there will be excavation of a trench about 10 m long, 1.5 m wide and 2 m deep on the upper beach, below the cliff. No clearing of vegetation is required as the area is within the range of storm surge. Nonetheless, the construction contract requires revegetation with local indigenous species if there is any loss of vegetation adjacent to the working area.

In the interest of safety, public access to the shore and within 500 m offshore will be restricted during construction. There will be no restrictions after the long outfall has been commissioned, apart from a ‘no anchor’ zone within 200 m of the diffuser.

**Construction Issues**

All construction will be carried out in accordance with an Environmental Management Plan (EMP) prepared by the contractor and approved by the Council. The EMP must include all commitments made in the DPEMP and all additional conditions imposed by planning and environmental agencies.

The requirements of Maritime Safety Tasmania (MAST) will include:

- Notification to public (by MAST) of construction period and activities, including exclusion zone;
- Exclusion zone of 500 m offshore to be marked by buoys and monitored by contractor at all times during construction;
- Pipeline strings towed only during daylight hours and moored at night with lights each end and at 25 m intervals along the pipe string;
- Controlled blasting underwater in accordance with Australian Standard 2187.2, with provisions for inspections prior to any blasting.

Blasting is limited to a maximum of 50 m length and will be carefully controlled to avoid landslips. Overall, it is anticipated there will be about 6 blasting events on the shore over a period of 2 weeks and about 3 blasting events offshore. All blasting will be designed to concentrate energy locally and will be carried out in accordance with the requirements of AS 2187.2. No offshore blasting will occur if dolphins or whales are observed to be within 1 km of the site.

On the foreshore, a trench about 10 m long and 2 to 3 m deep will be excavated for the connection chamber and pipe. The surface material is sand, with rock below. Excavation will be done using an excavator, with some blasting perhaps required for the lower 1 m depth.
Across the shore, a trench about 30 m long and up to 2 m deep will be excavated for the de-aeration chamber and the buried section of the pipeline. The seabed in this area is a mixture of rock, boulders, pebbles and sand. The trench will be dug by an excavator, with minor blasting required. The effects of blasting will be monitored with a commitment to keep the increase in turbidity below 5 NTU within 80 m of the blast site, and ensure there is clear water again in a few hours.

Further offshore, it is proposed to install the pipeline on the seabed along an offshore alignment selected to minimise rock excavation. Individual boulders along the alignment will be moved using air bags and a marine vessel. Large rocks will be drilled with a chemical expander to split them.

The outfall alignment and the construction procedure have been planned to minimise damage to string kelp and other marine flora and fauna. A passage through the kelp for the pipeline will be established by tying kelp back from the route to the extent feasible. Otherwise, the top growth of the kelp will be trimmed, protecting the holdfast and stem for later re-growth.

Procedures to avoid oil and fuel spills (and steps to manage any spill that may occur) will be set out in the EPP following the proposals set out in “Environmental Best Practice Guidelines 2 – Construction Practices for Waterways and Wetlands”.

It is anticipated that the pipeline will be brought to site and installed in four strings each 144 m long. Thus there will only be limited periods when vessels are working along the pipeline route.

2.2 Related Projects
The proposal does not include any change in the treatment processes or the quality of the effluent. However a subsequent project, that is also a part of the Kingborough Sewerage Strategy, involves augmenting the treatment facilities at Blackmans Bay to reduce nutrient levels in the discharge.

Effluent reuse alternatives have been assessed in the development of the Kingborough Sewerage Strategy and the options are described in Section 2.4.

Blackmans Bay WWTP
The Kingborough Council maintains and operates the sewerage systems for the municipality which includes the reticulation networks, pumping stations, six wastewater treatment plants (including the Blackmans Bay wastewater treatment plant) and four outfalls (at Blackmans Bay, Taroona, Margate and Electrona).

The Blackmans Bay plant is the largest in the municipality and currently provides biological secondary treatment for an average flow of 4.1 ML/d. The treatment processes are as follows:
- Fine screens, to remove detritus
- Primary sedimentation, to remove grease and solids that settle;
- Biological secondary treatment, to remove fine solids and organic material;
- Disinfection, to destroy coliforms and pathogens.
The screenings are taken for disposal in a landfill. The sludge removed in primary and secondary treatment is digested and stabilised, before being taken away from the site. The effluent from the Blackmans Bay plant is at present discharged through an outfall extending a nominal 15 m offshore. The outfall is broken and needs to be replaced.

The plant currently serves 18,000 persons in Kingborough and has an average flow of 4.1 ML/d. Growth in the area is expected to increase the population served to 33,600 persons in 2030, when the discharge rate will be 8.0 ML/d. There are higher flows (up to 2 to 3 times the average flow) during prolonged periods of wet weather, but these are treated by the plant and the long outfall has been designed to discharge flows in both dry and wet weather.

As part of the Kingborough Sewerage Strategy, it is proposed to upgrade the Blackmans Bay treatment plant to remove nutrients, so that the effluent meets more stringent DPIWE guidelines for discharges to marine waters (DPIWE, 2004).

2.3 Purpose of Outfall and Diffuser

The purpose of the outfall and diffuser is to discharge the effluent away from shore and at sufficient depth to achieve a high initial dilution at current and future flows. A high dilution is necessary to prevent adverse effects of the fresh water and the nutrients in the discharge on marine biota in the vicinity of the discharge.

The existing outfall discharges through an open-ended pipe into shallow water adjacent to a rocky outcrop - at a depth of 1.5 m below mean sea level. As a result, the initial dilution (the dilution achieved due to the momentum and buoyancy of the discharge) is only 4:1. The dilution increases with distance from the outfall as the effluent field is conveyed away by tidal currents and mixed by dispersion and waves.

As discussed later in this DPEMP, monitoring studies have found that there are adverse local effects in the zone in which the initial dilution is consistently less than 50:1. These effects are considered to be due to the effects of reduced salinity (due to the fresh water discharge), nutrients and ammonia. The adverse environmental effects resulting from low dilution will be eliminated by incorporating a diffuser that achieves a high initial dilution.

The minimum initial dilution with the replacement outfall and diffuser will be 130:1 at the long term future discharge of 8 ML/d (see Table 2-1) and higher at 190:1 at the current discharge rate of 4.1 ML/d.

A mixing zone that extends 100 m from the ports of the diffuser has been proposed based on this minimum initial dilution. However, it is recognised that the dimensions of any mixing zone will be set in the permit conditions issued by the Environment Protection Authority. The adequacy of the mixing zone dimensions will be reviewed through subsequent monitoring.

As shown in Table 2-1, the average dilution at the edge of the mixing zone will be 180:1 at the future design flow and 250:1 at the current discharge rate of 4.1 ML/d.
Even when the estuary is stratified, the minimum initial dilution of the long term future discharge of 8 ML/d will be 100:1 or more. These predicted dilutions are substantially greater than those observed in field studies to have no effect on marine biota. The effluent field will not be visible, even during calm conditions.

The computer model used to predict initial dilution for the Blackmans Bay outfall has been used successfully for many outfalls in Australia and overseas. Measurements of actual dilution have shown that the model correctly predicts the initial dilution (SEWL, 2007).

In summary, the long outfall will provide a substantial improvement on the initial dilution achieved by the existing outlet, which is only 4:1. As discussed later, the toxicity and other adverse environmental effects resulting from the low dilution of the existing outlet will be eliminated.
Table 2-1. Predicted Initial Dilution in Surface Field at Discharge of 8 ML/d

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>WIDTH (m)</th>
<th>INITIAL DILUTION</th>
<th>VELOCITY (m/s)</th>
<th>HORIZ (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.00</td>
<td>0.2</td>
<td>1.4</td>
<td>0.74</td>
<td>0.09</td>
</tr>
<tr>
<td>12.58</td>
<td>0.5</td>
<td>4.6</td>
<td>0.38</td>
<td>0.82</td>
</tr>
<tr>
<td>11.81</td>
<td>0.7</td>
<td>8.9</td>
<td>0.35</td>
<td>1.21</td>
</tr>
<tr>
<td>10.98</td>
<td>1.0</td>
<td>14.5</td>
<td>0.33</td>
<td>1.44</td>
</tr>
<tr>
<td>10.13</td>
<td>1.2</td>
<td>21.1</td>
<td>0.31</td>
<td>1.61</td>
</tr>
<tr>
<td>9.27</td>
<td>1.4</td>
<td>28.8</td>
<td>0.29</td>
<td>1.73</td>
</tr>
<tr>
<td>8.41</td>
<td>1.7</td>
<td>37.4</td>
<td>0.28</td>
<td>1.83</td>
</tr>
<tr>
<td>7.55</td>
<td>1.9</td>
<td>46.9</td>
<td>0.27</td>
<td>1.91</td>
</tr>
<tr>
<td>6.68</td>
<td>2.1</td>
<td>57.3</td>
<td>0.26</td>
<td>1.98</td>
</tr>
<tr>
<td>5.82</td>
<td>2.4</td>
<td>68.4</td>
<td>0.25</td>
<td>2.03</td>
</tr>
<tr>
<td>4.95</td>
<td>2.6</td>
<td>80.4</td>
<td>0.24</td>
<td>2.08</td>
</tr>
<tr>
<td>4.09</td>
<td>2.9</td>
<td>93.1</td>
<td>0.23</td>
<td>2.13</td>
</tr>
<tr>
<td>3.22</td>
<td>3.1</td>
<td>106.5</td>
<td>0.23</td>
<td>2.17</td>
</tr>
<tr>
<td>2.36</td>
<td>3.3</td>
<td>120.7</td>
<td>0.22</td>
<td>2.20</td>
</tr>
</tbody>
</table>

Surface has been reached
Plume stops at a depth of 1.8 m
And a MINIMUM DILUTION of 130 TO 1

Average dilution at the edge of the mixing zone is 180 TO 1
2.4 Site Plan

Figure 2-1 shows the layout of the Blackmans Bay treatment plant. The three circular structures seen in the photo are the primary sedimentation tank, the sludge digester and the secondary clarifier. The existing outfall can be seen as the pipeline extending down the cliff from the centre of the plant and across the rocks at the base of the cliff. The long outfall will extend offshore through the gap in the rocks just to the north of the existing outfall (see drawings in Appendix A).

A plan and long section of the long outfall are shown in Drawing 001 (see appendices). The long outfall will commence at a connection chamber at the base of the cliff. The steep cliff and narrow beach make public access difficult, and the area at the base of the cliff is used only by a small number of surfers. The construction works are not expected to cause any interference with public use of the parkland at the top of the cliff.

![Figure 2-1. Blackmans Bay Treatment Plant and Outfall](image)
2.5 Off-site Infrastructure
Because the cliff limits access to the shore by equipment, the pipes for the long outfall will be fabricated into strings at another site in the Derwent estuary and towed into position by a work boat. The pipeline will be fabricated by welding 12 m long HDPE pipes into pipe strings up to 144 m long at a slipway in the Derwent estuary away from the outfall. No liquid or other wastes are produced and the noise levels should be no more than for boat maintenance and repairs.

The concrete blocks to hold the HDPE pipes in position will be cast elsewhere and brought to slipway site and attached to the pipe strings as they are towed offshore. The four pipe strings will be towed one at a time to Blackmans Bay, sunk into position and secured on the seafloor.

The pipe fabrication area will be in use for about six weeks or so. This area will be arranged by and under the control of the installation contractor, and work will be carried out under the requirements of the EMP developed by the Contractor.

2.6 Technical and Management Alternatives
The Environmental Risk Assessment (ERA) for the Blackmans Bay treatment plant and outfall considered various alternatives, which are described below.

Reuse of Effluent
An obvious alternative is to explore the potential for effluent reuse, which would reduce or ultimately eliminate the discharge of effluent.

A strategic planning study was carried out to develop and cost various scenarios for reuse of effluent, including reuse of 100% of effluent from Kingborough throughout the year or alternatively, reuse of all effluent in the summer months only (when there is a demand for irrigation water).

The study found that reuse opportunities are limited in Kingborough because of the small area of agriculture, steep terrain, rocky soils and high rainfall. Given these natural constraints, the only suitable location for 100% reuse is on Bruny Island. For 100% reuse, this would require an area of 1,400 ha for irrigation plus a 500 ML storage (covering an additional area of about 4 ha). A pipeline across the channel between Tinderbox and Bruny Island would be required. The estimated capital cost was $80 million and a substantial sum would be required each year for pumping (CEE, 2007). The reuse proposed would substantially increase energy use in the Kingborough sewerage system.

For reuse of all effluent in the summer months only, an area of 700 ha would be required for irrigation and a 100 ML storage (covering an additional area of about 1 ha). A pipeline across the channel between Tinderbox and Bruny Island would be required. The estimated capital cost was $50 million and a substantial sum would be required each year for pumping.

After discussion of the reuse options with stakeholders, it was decided not to pursue reuse of effluent on Bruny Island.
Other local reuse options within Kingborough to the north of Margate, including on the golf courses and on playing fields adjacent to the Taroona treatment plant, are being pursued. The proposed outfall will operate satisfactorily with lower flows should a high proportion of effluent be reclaimed in the future.

**Increasing Removal in Treatment**

It is proposed to expand the treatment processes at Blackmans Bay to improve effluent quality. The upgrade in treatment will increase the removal of ammonia and reduce the total nitrogen discharged. The upgrade will involve additional tank capacity, oxygen input and power consumption at the treatment plants, and is necessary to meet government requirements for effluent quality whether the outfall is extended or not. Table 2-2 summarises:

- The current DTAE discharge licence requirements for WWTPs discharging to water;
- The Interim discharge requirements for existing plants (*Emission Limit Guidelines for Sewage Treatment Plants*, Appendix 2, DPIWE June 2001); and
- Emission Limits – Acceptable Technology for New and Upgraded Plants (*Emission Limit Guidelines for Sewage Treatment Plants*, Table 1, DPIWE June 2001).

It can be seen in Table 2-2 that increasingly stringent effluent quality requirements will apply in the future. Treatment plants will have to reduce suspended solids and BOD levels down to a median of <10 mg/L; ammonia levels will be limited to only 1 mg/L and nutrient removal will be required to achieve the target limits of 7 mg/L for total nitrogen and 1 mg/L for total phosphorus.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Current Licence Limit</th>
<th>Interim Discharge Max Reqs</th>
<th>Emission Limit Guidelines for New and Upgrades Treatment Plants 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>90%ile</td>
<td>Max</td>
</tr>
<tr>
<td>Suspended solids, mg/L</td>
<td>60</td>
<td>20 (60)</td>
<td>10</td>
</tr>
<tr>
<td>BOD, mg/L</td>
<td>40</td>
<td>20 (40)</td>
<td>10</td>
</tr>
<tr>
<td>Grease and Oil, mg/L</td>
<td>10</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Ammonia-N, mg/L</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total nitrogen-N, mg/L</td>
<td>30</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Total phosphorus-P, mg/L</td>
<td>15</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>pH</td>
<td>6.5-8.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermo coliforms/100 mL</td>
<td>1,000</td>
<td>200</td>
<td>500</td>
</tr>
<tr>
<td>Enterococci/100 mL</td>
<td>230</td>
<td>230</td>
<td>230</td>
</tr>
<tr>
<td>Chlorine, mg/L</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Current DTAE licence
2 Interim discharge requirements for existing plants (*Emission Limit Guidelines for Sewage Treatment Plants*, Appendix 2, DPIWE June 2001)
3 Emission Limits – Acceptable Technology for New and Upgraded Plants (*Emission Limit Guidelines for Sewage Treatment Plants*, Table 1, DPIWE June 2001)
4 Where 50:1 dilution is achieved
**Do Nothing**

It is possible to do nothing. This would mean the existing outfall would remain in place and continue to be used. The same quantity of effluent would be discharged to the estuary, but closer to shore and with low dilution. The adverse environmental impacts and health risks arising from insufficient initial dilution would continue.

The ‘do nothing’ option is not adopted because it does not meet the environmental objectives of the Council or of the State Government.

### 2.7 Key Issues

The key issues that were identified by the Department of Environment, Arts, Heritage and the Arts (DEPHA) for consideration in relation to the proposal, and which are the principal focus of the DPEMP, are as follows:

- **Potential effects on ambient water quality in the Lower Derwent Estuary associated with operation of the outfall, including effects relating to:**
  - Aquatic biota;
  - Commercial and recreational activities; and
  - Public health.

- **Potential effects associated with the construction of the outfall, including effects relating to:**
  - Aquatic flora and fauna;
  - Geomorphology; and
  - Public amenity.

Work undertaken in developing the proposal which responds to these key issues is summarised below.
2.7.1 Aquatic Biota
Extensive biological studies have been carried out in the region of the existing and long outfall to establish (1) existing marine biological conditions and the (2) the zone of impact of the existing outfall. The key studies included:

- Mapping composition of seabed and associated biota;
- Establishing extent and health of giant string kelp;
- Considering potential effects on rare and endangered species;
- Survey to establish if marine pest species are evident;
- Establishing effect of existing discharge on string kelp;
- Establishing effect of existing discharge on algae;
- Relating zone of impact to dilution of effluent;
- Bioassay studies to establish minimum dilution having no impact;
- Selecting alignment to limit impact on string kelp habitat;
- Designing diffuser to avoid adverse effects on string kelp and algae;
- Baseline studies on infauna.

The biological studies are described in the attached report (Blackmans Bay Outfall – Marine Biological Studies, 2008) and the findings are summarised in the DPEMP.

2.7.2 Commercial and Recreational Activities
The beach at the outfall is narrow and is essentially covered by water at times of high tides and storms. It is difficult to access from land, as it is at the base of a steep cliff below the fenced site of the treatment plant, or from the sea – string kelp chokes boat propellers. Thus the main use of the beach is by surfers who use the outfall as a passage to enter the water.

2.7.3 Public Health
The health risk assessment identified the problem of direct contact of surfers with the effluent, even though it has been disinfected (CEE, 2007). This primary contact will cease when the discharge is 600 m offshore.

2.7.4 Geomorphology
A search of significant local geomorphology sites was undertaken, and the proposal will not affect any of them.

The cliff and rocky beach of Blackmans Bay are significant local landforms and the outfall construction method has been devised to minimise the effects by:

- Burying the outfall in a trench across the shore and near-shore zones,
- Using local rock to face the top of the reinstated trench;
- Environmental and quality management plan for the project;
- Selection of alignment to minimise length of bedrock and kelp;
- Where possible mechanically move rocks and minimise blasting;
- Designing replacement offshore pipeline so it will not be visible and the beach and shore area will look the same after construction as before.
2.8 Proposed Construction Arrangements

The connection structure and long outfall will be constructed by a single contractor supervised by the engineering section of Kingborough Council.

The first step in construction will be to purchase the pipe (600 m of 500 mm diameter HDPE pipe), fabricate the concrete anchor blocks and obtain all other supplies (straps, chamber, and connecting flanges).

The pipeline will be fabricated by welding 12 m long HDPE pipes into pipe strings up to 144 m long at a slipway in the Derwent Estuary away from the outfall. The concrete blocks to hold the HDPE pipes in position will be cast elsewhere and attached to the pipe strings as they are towed off the slipway. The pipe strings with anchor blocks will be towed to the site by a work boat, sunk onto the seabed and secured in place.

It is anticipated that all construction work on the site will be completed over a 3-month summer period, working from 7.30 am to 7.30 pm Monday to Friday, and from 8 am to 5 pm on Saturday. There will be no work on Sundays or public holidays.

The expected sequence of work in Month 1 is as follows.

- Excavate trench on foreshore for connection chamber and pipe. This trench will be about 10 m long, 1.5 m wide and 2 to 3 m deep. The surface material is sand, with rock below. Excavation will be done using an excavator, with some blasting required for the lower 1 m depth. It is anticipated that there will be about 3 blasting shots over a period of 6 days.
- Install connection chamber.
- Excavate trench across shore for de-aeration chamber and buried section of pipeline. This trench will be about 30 m long and up to 2 m deep. The seabed is a mixture of rock, boulders, pebbles and sand. Excavation will be done using an excavator, with some blasting required. It is anticipated that there will be about 3 blasting shots over a period of 6 days.
- Install de-aeration chamber.
- Backfill and concrete trench; face with local rock.
- Make detailed survey of offshore alignment and plan pipeline installation.
- Fabricate pipeline strings (elsewhere).

The expected sequence of work in Month 2 is as follows.

- Tie back kelp to create path for vessel.
- Install line along offshore alignment (selected to minimise rock excavation).
- Move individual boulders along alignment using air bags and vessel on the surface.
- Drill rocks with chemical expander to split them and make a path for the pipe.
- As a last resort, blast remaining bedrock near the shore on the path. It is anticipated that there will be about 3 blasting shots over a period of 6 days.
- Check that path for the pipeline is clear and at the correct grade. Tow floating pipeline strings into position using boat and winch on the shore.
- Sink and secure pipeline string to alignment and grade.
- Once beyond rock and kelp, bring three more pipe strings into position, connect to installed pipe and sink and secure pipe to alignment and grade.
The expected sequence of work in **Month 3** is as follows.

- Complete installation of pipeline and diffuser.
- Colour structures to match cliff.
- Revegetate any disturbed soil (not sand or rock) with local indigenous plants.
- Install all straps needed to secure pipe to rock.
- Construct tie-in and anchor block on existing pipeline.
- Install ports on diffuser.
- Install valves on ports in kelp forest.
- Check pipe ready to be commissioned.
- Release ties on kelp.
- Remove all temporary works and excess materials.

The existing outfall will keep operating throughout the construction program. However, when divers are working adjacent to the end of the outfall, secondary effluent will be stored in the chlorine contact tanks at the treatment plant for a few hours and released later as a higher flow rate in the afternoon. This temporary storage will not create any additional odours as secondary effluent will be stored.

### 2.9 Proposed Commissioning Arrangements

The long outfall will be commissioned by installing a plug in the existing outfall at the anchor block, just beyond the tie-in structure, and then diverting flow to the new connection chamber and outfall. This work will be done in a few hours.

After commissioning, the operation of the de-aeration structure, diffuser and ports to release nutrients to supply the kelp will be checked.

Subsequently, the dilution achieved by the new diffuser will be checked using either a fluorescent dye or a sensitive salinity probe.

As described later in this DPEMP, a marine biological monitoring program will be carried out, with surveys at six monthly intervals for the first three years of operation. The marine biological monitoring program will:

- Monitor the effect of the effluent discharge on infaunal communities in the vicinity of the proposed diffuser location;
- Monitor any changes in *Macrocystis* abundance and associated community conditions due to reduction in nitrogen loads into the embayment;
- When appropriate, adjust the three ports near the kelp to optimise the supply of nutrients to the kelp; and
- Monitor the recovery of algae and associated species within 100 m of the existing outfall.
3 THE EXISTING ENVIRONMENT

3.1 Planning Aspects

Kingborough municipality is close to Hobart, with coastline frontage to the Derwent Estuary and North West Bay, undulating topography, natural beauty and recreational opportunities. The municipality is growing rapidly, with a growth rate averaging 2.1 per cent, which is nearly double the national average. In recent years, about 40 per cent of Tasmania’s population growth has occurred in Kingborough. One of the challenges faced by Kingborough Council is the expansion of sewerage infrastructure to keep pace with population growth.

The treated effluent from the treatment plant at Blackmans Bay is discharged to the lower Derwent Estuary through short outfalls. The effluent quality from the plants meet current requirements for discharge to coastal waters, but more stringent effluent requirements have been proposed by the Department of Primary Industries, Water and Environment (DPIWE, 2004) and thus the plant is to be upgraded, as noted above.

Kingborough Council operates five other treatment plants - two medium-sized treatment plants (at Taroona and Electrona), one lagoon treatment plant (at Margate) and two small package plants (for Howden and Woodbridge). This proposal concerns only the Blackmans Bay plant.

A summary of the population served by each plant in 2005, and the projected future population in the catchments, is given in Table 3-1. It can be seen that the population sewered is projected to increase from 23,205 persons in 2005 to 43,800 persons in 2030, an increase of 89 per cent, with most of the growth in the Blackmans Bay catchment.

<table>
<thead>
<tr>
<th>Sewerage Catchment</th>
<th>Year 2005</th>
<th>Year 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackmans Bay</td>
<td>17,961</td>
<td>33,600</td>
</tr>
<tr>
<td>Taroona</td>
<td>3,003</td>
<td>3,150</td>
</tr>
<tr>
<td>Margate</td>
<td>1,299</td>
<td>4,760</td>
</tr>
<tr>
<td>Electrona/Snug</td>
<td>690</td>
<td>1,680</td>
</tr>
<tr>
<td>Howden</td>
<td>216</td>
<td>560</td>
</tr>
<tr>
<td>Woodbridge</td>
<td>36</td>
<td>84</td>
</tr>
<tr>
<td><strong>All Kingborough</strong></td>
<td><strong>23,205</strong></td>
<td><strong>43,800</strong></td>
</tr>
</tbody>
</table>

The Blackmans Bay plant is located on Tinderbox Road East, adjacent to the lower Derwent Estuary at Blackmans Bay. The plant currently treats an average flow of 4.1 ML/d by primary and biological secondary treatment using the activated sludge process. A good quality secondary effluent is achieved. The typical effluent quality is shown in Table 3-2.
Table 3-2. Present Median Effluent Quality from Blackmans Bay WWTP

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Susp. Solids</td>
<td>15 mg/L</td>
</tr>
<tr>
<td>BOD</td>
<td>12 mg/L</td>
</tr>
<tr>
<td>Ammonia</td>
<td>34 mg/L</td>
</tr>
<tr>
<td>Total N</td>
<td>30 mg/L</td>
</tr>
<tr>
<td>Total P</td>
<td>9.3 mg/L</td>
</tr>
</tbody>
</table>

There are no significant industrial sources of waste water in the Blackmans Bay catchment and although there are some commercial sources, analyses show that the treated effluent has low concentrations of metals and pesticides. As an example, a recent analysis of metals and pesticides in the effluent (June 2008) is shown in Table 3-3. It can be seen that metal and pesticide levels are very low.

Table 3-3. Analysis of Blackmans Bay Effluent

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>&lt;1 µg/L</td>
</tr>
<tr>
<td>Cadmium</td>
<td>&lt;0.1 µg/L</td>
</tr>
<tr>
<td>Chromium</td>
<td>4 µg/L</td>
</tr>
<tr>
<td>Copper</td>
<td>0.012 mg/L</td>
</tr>
<tr>
<td>Mercury</td>
<td>&lt;0.05 µg/L</td>
</tr>
<tr>
<td>Nickel</td>
<td>2.4 µg/L</td>
</tr>
<tr>
<td>Lead</td>
<td>0.9 µg/L</td>
</tr>
<tr>
<td>Selenium</td>
<td>&lt;5 µg/L</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.03 mg/L</td>
</tr>
<tr>
<td>1405-Water PCB</td>
<td>&lt;0.1 µg/L</td>
</tr>
<tr>
<td>1501-Water a-BHC</td>
<td>&lt;0.1 µg/L</td>
</tr>
<tr>
<td>Aldrin</td>
<td>&lt;0.1 µg/L</td>
</tr>
<tr>
<td>b-BHC</td>
<td>&lt;0.2 µg/L</td>
</tr>
<tr>
<td>Chlordane</td>
<td>&lt;0.5 µg/L</td>
</tr>
<tr>
<td>d-BHC</td>
<td>&lt;0.2 µg/L</td>
</tr>
<tr>
<td>Dieldrin</td>
<td>&lt;0.2 µg/L</td>
</tr>
<tr>
<td>g-BHC</td>
<td>&lt;0.1 µg/L</td>
</tr>
<tr>
<td>Heptachlor</td>
<td>&lt;0.1 µg/L</td>
</tr>
<tr>
<td>Hexachlorobenzene</td>
<td>&lt;0.2 µg/L</td>
</tr>
<tr>
<td>p,p'-DDD</td>
<td>&lt;0.1 µg/L</td>
</tr>
<tr>
<td>p,p'-DDE</td>
<td>&lt;0.2 µg/L</td>
</tr>
<tr>
<td>p,p'-DDT</td>
<td>&lt;0.1 µg/L</td>
</tr>
</tbody>
</table>

As the population in Kingborough increases, the flows to the treatment plants will increase. The design projections for Blackmans Bay WWTP provide for the average daily flow to increase from 4.1 ML/d at present to 8 ML/d in the long term.
Kingborough has relatively even rainfall throughout the year, from a minimum of 40 mm in February to 62 mm in October (see Figure 3-1). During periods of prolonged wet weather, or on days with high rainfall, the flow to the treatment plant increases to 2 to 3 times the dry weather flow as a result of stormwater entering the sewers. All wastewater is treated and discharged through the outfall – there are no bypasses of treatment units. Stormwater inflow tends to dilute the sewage and there is no significant reduction in effluent quality during wet weather.

![Figure 3-1. Average Annual Rainfall in Kingborough](image)

The effluent is discharged to the lower Derwent Estuary via an outlet pipe extending about 15 m from the shore across a rock shelf into shallow water adjacent to a rocky outcrop (see Figure 3-2).

![Figure 3-2. Existing Blackmans Bay Outfall](image)
3.1.1 Site Zoning and Land Ownership
The Blackmans Bay WWTP site is zoned public purposes in the Kingborough Planning Scheme and the site is owned by the Council.

The existing outfall passes through a coastal reserve administered by Crown Lands. The Council will obtain the approval of Crown Lands to construct the long outfall.

As shown in Figure 3-3, there are residential houses about 350 m to the north of the treatment plant. These houses have experienced odour problems in the past, but odour controls have been upgraded in 2007-08 to address this problem. To the south, there is a public reserve that is used for dog walking, the scouts and passive recreation.

Figure 3-3. Blackmans Bay WWTP Locality Plan and Environs
3.1.2 Tinderbox Marine Protected Area

The Commission recommended that the Tinderbox marine protected area, which extends around the southern coast of the Tinderbox Peninsula, be extended from 55 ha to 123 ha. This area comprises a strip along the coast which is to be maintained as a scientific reference area and used for recreation, tourism and education (existing snorkel trail and diver training).

The Tinderbox marine protected area commences at 4 km to the south of Blackmans Bay, and will not be affected by the proposal.

3.1.3 Aquaculture
There are extensive aquaculture farms around Bruny Island. These are more than 6 km from Blackmans Bay, and will not be affected by the proposal.

3.1.4 Protected Environmental Values
Protected Environmental Values (PEVs) are the values or uses of the water body for which it is determined that any given area of that water body should be protected.

Protected Environmental Values for the Derwent Estuary are derived from the report Environmental Management Goals for Tasmanian Surface Waters – Derwent Estuary Catchment (DPIWE, 2003) and are as follows:

- Protection of aquatic ecosystems (particularly the string kelp in Blackmans Bay);
- Protection of marine protected areas (Tinderbox, as discussed elsewhere);
- Recreational water quality (swimming, boating and fishing);
- Passive recreation and visual amenity.
3.2 Environmental Aspects

3.2.1 Estuarine Environmental Context
The existing Blackmans Bay outfall is on the western shore of the lower Derwent Estuary. The lower Derwent Estuary extends for 20 km from the Tasman Bridge to the Iron Pot. In this region, the estuary is 4 to 6 km wide, with urban development along the western shore (Kingborough and Hobart) and most of the eastern shore (Clarence).

Currents and circulation in the estuary are caused by the combined influences of tides, winds, freshwater inputs from rivers and stormwater runoff and major ocean current patterns at the mouth of the estuary.

The Derwent Estuary has a well-formed saline water circulation with fresh and brackish water flowing out to sea in the upper layer and a net inward flow of seawater in the lower layer. The vertical stratification is particularly strong upstream of the Tasman Bridge and much weaker in the lower estuary although it still has a strong influence on current patterns.

The Derwent River is the major source of fresh water to the estuary, with an annual average discharge of 90 m$^3$/s. There is a strong seasonal variation in the flow rate, from a minimum of 50 m$^3$/s in autumn to a maximum of 140 m$^3$/s in spring. Other tributaries are the Jordan River, which enters at Bridgewater and contributes about 1 m$^3$/s on average. There are several small perennial streams entering the estuary in Hobart and Kingborough and minor ephemeral streams along the eastern shore.

The discharge from the Blackmans Bay plant (currently 4.1 ML/d) is only 0.05 per cent of the total fresh water input to the estuary. Thus, while there is a localised effect due to the presence of fresh water near the outfall, the discharge does not have a significant influence on the currents or salinity distribution in the estuary. The future multi-port diffuser on the long outfall at Blackmans Bay will produce a high initial dilution and eliminate any future adverse effect of the freshwater input from the discharge, but also will have no effect on currents and circulation in the estuary.

The Derwent estuary has only one tide per day, with a tidal range of 0.3 to 1.3 m. Because of the long tidal period and small tidal range, tidal currents are relatively weak, typically being in the range of 0.02 to 0.16 m/s. The water circulation created by stratification creates an outflow current of 0.1 to 0.3 m/s in the upper layer of the estuary and an inflow current of 0.02 to 0.05 m/s in the lower layer.

During winter and early spring, nutrient-rich sub-Antarctic waters intrude into the lower Derwent estuary, producing elevated nutrient levels in those seasons. In summer, the inflowing ocean waters are nutrient-poor subtropical waters from the East Australian Current, causing lower nutrient levels in summer and autumn.
3.2.2 Meteorological Context

Figure 3-4 shows wind roses for the Hobart monitoring site at Ellerslie Road, which is representative of conditions at Blackmans Bay. In the wind rose, the frequency of winds from each of the sixteen segments of the compass is depicted. The length on the bar in each segment represents the proportion of the winds coming from that direction. The longer the bar, the more frequently wind blows from that direction. The width of the bars in the segments represents the wind speed, with the wider segments representing stronger winds, and the thin lines near the centre representing weak winds (less than 2 m/s).

It can be seen in Figure 3-4 that, over the year, the most common winds come from the northwest to north directions. Strongest winds (greater than 10 m/s) come from most sectors, except from northeast to east. Shear from the dominant winds from the north and north-west encourages the net outflow current in the surface layer of the estuary.

![Figure 3-4. Wind Rose for Hobart – Ellerslie Road (all hours)](image-url)
3.3 Implications of Replacement Outfall

The proposal is to replace the existing short outfall with a long outfall extending from the same location. There will be no change in the quality of effluent discharged, which will continue to be disinfected effluent from the Blackmans Bay WWTP.

The main changes in conditions will be evident close to the outfall, as the old outfall achieves a dilution of 4:1 while the long outfall will achieve an initial dilution of more than 100:1. In contrast, at a distance of a kilometre or more from the outfall, it will make very little difference as to whether or not there is a long outfall with greater initial dilution, as dilution due to ambient turbulence will have considerably exceeded the initial dilution.

This point may be illustrated by considering ammonia concentrations. Ammonia is a toxicant. Section 8.3.7.2 of the ANZECC Guidelines for Marine and Freshwater Quality lists trigger levels for ammonia to provide 95% protection to marine species in slightly-moderately disturbed ecological systems (such as the Derwent Estuary). For marine waters, ANZECC recommends a general trigger level for total ammonia of 0.7 mg/L.

The median ammonia level in the current effluent is 34 mg/L. After an initial dilution of 4:1, the ammonia level is reduced to 8.5 mg/L. This is still above the trigger concentration of 0.7 mg/L. However, with the long outfall, the ammonia level after initial dilution will be only 0.34 mg/L, well below the trigger concentration.

Figure 3-5 shows the measured reduction in ammonia concentration with distance from the old outfall and new long outfall. It can be seen that the ammonia level is below the trigger level at about 100 m from the old outfall or immediately after initial dilution for the long outfall.

![Figure 3-5. Dilution of Ammonia for Old Outfall and Long outfall](image-url)
The situation for other constituents and environmental impacts is much the same as for ammonia. As discussed below, the indirect ecological effects of the discharge from the old outfall are not discernible beyond about 340 m south, 320 m north and 200 m offshore (east) of the existing outfall.

3.3.1 Salinity
As noted above, the Derwent is a stratified estuary. Salinity profiles were measured through the water column approximately 1 km offshore from Blackmans Bay outfall between 2003 and 2005. The monthly profiles for 2004 are shown in Figure 3-6.

The profiles show that salinity in the estuary, approximately 1 km offshore from Kingborough, varies seasonally due to freshwater flows, oceanic intrusion and vertical mixing. The figure demonstrates that for 2004:

- There was significant stratification in the top 5 m of the water column for much of the year;
- Surface waters were strongly stratified with respect to salinity in July, August and September;
- Salinity was lowest in September due to spring freshwater flows from the Derwent River; and
- Salinity was highest and stratification weakest during June, due to low river flows, strong oceanic intrusion and strong vertical mixing.

![Figure 3-6. Salinity Profiles Offshore from Blackmans Bay](image-url)
3.3.2 Temperature
Temperature profiles were measured through the water column approximately 1 km offshore from Blackmans Bay outfall between 2003 and 2005 simultaneously with salinity. The monthly profiles for 2004 are shown in Figure 3-7.

The profiles show that temperature in the western estuary approximately 1 km offshore from Blackmans Bay varies seasonally due to freshwater flows, oceanic intrusion and vertical mixing. The figure demonstrates that for 2004:

- Waters were warmest in December, January and February with a peak water temperature of 17º C and weak thermal stratification;
- Waters were coldest in July and August, with a minimum water temperature of 10º C and some vertical stratification due to lower density, but cooler, freshwater layers;
- March also showed some stratification, due to lower density, cooler, freshwater layers rather than thermal stratification affecting density.

Figure 3-7. Vertical Temperature Profiles Offshore from Blackmans Bay
3.3.3 Ammonia
The results of water column monitoring of ammonia at the surface and seabed are shown in Figure 3-8. The results show substantial variation between the ammonia concentrations near the surface and near the seabed. This is due to the influence of the fresher layer near the surface.

There is a general pattern of higher ammonia concentrations during winter and lower ammonia concentrations during summer. This is a combination of intrusion of oceanic, nutrient-rich waters from the Southern Ocean in winter and the influence of lower nutrient waters in summer.

![Ammonia Concentration Offshore from Blackmans Bay](image)

3.3.4 Oxidised Nitrogen
The results of water column monitoring of oxidized nitrogen at the surface and seabed are shown in Figure 3-9. The results show similar oxidized nitrogen concentrations near the surface and the seabed.

There is a strong pattern of higher nitrogen concentrations during winter and lower nitrogen concentrations during summer. This is a combination of intrusion of oceanic, nutrient-rich waters from the Southern Ocean in winter and the intrusion of lower nutrient waters in summer.
3.3.5 Total Phosphorus
The results of water column monitoring of total phosphorus at the surface and seabed is shown in Figure 3-10. The results show the concentrations at the surface and the seabed during the period of monitoring were generally consistent in each survey.
3.4 Marine Biological Assessment

The DPEMP Guidelines for this proposal require marine investigations to obtain information on marine biodiversity and conservation. A separate report on the marine biological investigations has been prepared (CEE, 2008). A summary of the findings on the impacts of the existing discharge on marine biota, the potential impacts of the proposed works on the local marine biota and the implications of construction activities on marine biota is presented below.

The key components of the marine biological community near the Blackmans Bay outfall are:
- Giant string kelp (*Macrocystis pyrifera*);
- Common kelp (*Ecklonia radiata*);
- Foliose red seaweeds - predominantly *Plocamium* species;
- Coralline encrusting algae - flat coral-like pink algae that form a paint-like crust on rocks; and
- Encrusting red algae - predominantly *Feldmania* (a dark red to purple coloured alga that forms a leathery crust on rocks).

Giant string kelp requires nitrogen-rich water in a well mixed marine environment and, in Tasmania, string kelp is most abundant on the south-east coastline. The forest of string kelp in Blackmans Bay is the largest and most luxuriant in the Derwent Estuary.

The biological surveys revealed that string kelp was common in the cove in which the outfall is located. Except close to the outlet, the discharge of nutrients from the Blackmans Bay outfall was assessed by marine biologists as having a positive effect on the abundance of string kelp. String kelp is most abundant at 240 m south and 180 m north of the existing outfall, beyond which the abundance decreased.

The initial dilution produced by the existing outfall at Blackmans Bay is only 4:1. The surveys of marine biota at Blackmans Bay revealed that, because of this low dilution, there are changes in the composition of marine communities that may extend as far as 340 m south, 320 m north and 200 m offshore (east) of the outlet.

The effects on the string kelp extend over a smaller range - with a possible inhibition within 30 m of the outlet, a stimulation from 150 m to 220 m north, from 160 m to 280 m south and from 20 to 200 m east, and no detectable effect thereafter.

Water quality sampling, supplemented by the dilution modelling, showed that the spatial extent of a toxic risk from the existing outlet could extend up to 200 m offshore from the Blackmans Bay outlet.

The long outfall will produce a minimum initial dilution (at the long term future discharge of 8 ML/d) of 100:1 to 130:1, which is sufficient to ensure that the local effects of the existing discharge will not continue after the long outfall has been commissioned. The increased dilution should eliminate the zones of inhibition and stimulation of string kelp and the local changes in composition of marine plant communities. The dilution with the long outfall will be sufficient to avoid any toxic effects.
3.4.1 Infauna
The diffuser for the long outfall will be located on soft seabed on the 13 m depth contour offshore from the Blackmans Bay treatment plant. The biota of the soft seabed comprises biota that live on the surface of the seabed (epibiota) and those that live within the seabed (infauna).

Inspection of the diffuser locality by divers found that epibiota were relatively sparse and comprise a variety of mobile invertebrates including hermit crabs and seastars. No substantial seaweeds were observed growing on the soft seabed.

The infauna community of the Derwent estuary was documented at widely spread locations in 2004/2005 by TAFI (Macleaod and Helidoniotis 2005). One sampling location was within 4 km of the proposed new diffuser site. Generally the infauna of the estuary in this region comprised a community of small burrowing crustaceans (sand fleas, lice and seed shrimps), small clams and worms.

These groups of infauna are often used to determine ecosystem health because the composition of the community responds to organic content, toxicants and other physico-chemical factors. Hence, infauna were sampled in the vicinity of the proposed outfall to provide:
- Information on the nature of infauna in the vicinity of the outfall location prior to construction and operation of the outfall; and
- Baseline data for an ongoing monitoring program.

Infauna were sampled at the following sites:
- The proposed outfall diffuser location;
- 200 m north and south of the proposed diffuser;
- 1000 m north and south of the proposed diffuser; and
- Previous TAFI sampling site (site 25) in the region.

Infauna were sampled at each site using the same technique as the TAFI study:
- Sediments were collected using a van Veen grab;
- Sediments were sieved through a 1 mm mesh;
- Remaining biota and material were fixed and preserved in formalin seawater solution;
- Biota in samples were counted and identified to family taxonomic level.
Results of Infauna Sampling
A total of 1,020 individual infauna, from 69 identifiable taxonomic groups were counted in the six samples (see Figure 3-11). More than 90 per cent of all organisms were distributed among 20 of the 69 taxa and more than 40 taxa had less than 5 individuals.

The abundance of the most abundant taxa (with total abundance of more than 5 individuals) at the six sites was analysed (see Figure 3-12) and it was established that there are substantial differences in the number of individuals between the sites and that the species composition between sites also is substantially different.

As there is no obvious point source in the vicinity of the sites, the variation is attributed to the natural variation in biological composition and local physico-chemical factors, such as seabed composition. This has important considerations for the monitoring program and potential detection of impacts of the discharge on infauna.

Figure 3-11. Infauna in Sediments at Proposed Diffuser Site
Figure 3-12. Abundance of Common Infauna at Monitoring Sites

**Potential Impacts on Infauna Community**

Potential impacts of the proposed outfall and discharge on infauna are likely to be a local enrichment of the community. These effects may be detectable as changes to the species composition and abundance of certain species. The effects of the effluent discharge on the infauna is likely to be greatest close to the diffuser and rapidly reduce as distance from the outfall increases.

The monitoring program has shown that there are substantial natural differences in the composition of the infauna assemblages from site to site over relatively small distances. Thus, a long term monitoring program with several reference sites will be necessary to detect changes in infauna populations. The recommended monitoring program is described in Chapter 5 of the DPEMP.
3.4.2 Screw Shell
A species of screw shell, *Gazameda gunni*, occurs on and in soft seabeds in certain conditions (see Figure 3-13). This 50 mm long, filter feeding screw shell lives on the surface of sandy seabeds and was recently listed as Threatened in Tasmania’s “Threatened Species Protection Act 1995”. This species is being geographically displaced by the introduced screw shell *Maoricolpus roseus*.

Figure 3-13. Depiction of Screw Shell
Screw Shell Monitoring Protocol

DEPHA requires sampling for Gazameda in areas of proposed marine developments according to the following draft protocol.

Gazameda gunnii sampling:
Sampling should be undertaken within areas of sandy substrate shell-grit and fine gravel occurring in depths of 3 to 80 m within development proposals. Sampling is not required within estuaries (including the Derwent River upstream from Taroona; the Huon River upstream of Police Point; the Tamar River upstream of the Batman Bridge; and Macquarie Harbour). Dead shells are to be retained and submitted, live shells are to be returned.

Sample number
The table below indicates the number of benthic grabs/cores (eg. van Veen grab, 15 cm diameter corer) that should be taken within relevant habitat in a development proposal area. If intact dead specimens (ie not shell fragments) of Gazameda gunnii with distinct nacre are collected in any of the initial samples then the number of samples should be doubled. Sampling should aim to cover the full depth range of suitable habitat but otherwise be randomly located.

<table>
<thead>
<tr>
<th>Area of relevant habitat, ha</th>
<th>Initial # of samples</th>
<th>Total samples if dead Gazameda gunnii present initially</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>&lt;5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>&lt;20</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>&lt;100</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>

Processing samples
Benthic samples should be sorted through a maximum sieve size of 4 mm. Any live Gazameda sp. should be photographed with a good quality macro-camera and then returned to the water. Dead shells should be retained and confirmed as Gazameda gunnii.

Results of Gazameda (Screw Shell) Survey
The proposed outfall construction will affect an area of about 0.7 ha of seabed. Hence the screw shell sampling protocol requires that a minimum of three sediment samples be collected and examined for screw shells. As a precaution, five sediment samples were collected and examined. The sediment samples were collected using a van Veen grab from the proposed diffuser location and 100 m and 200 m either side of the proposed outfall location on 8 December 2007. The sediment samples were sieved through a 1 mm mesh screen and examined for the presence of living or dead Gazameda according to the above protocol.

The five sediment samples assessed for the presence of living or dead Gazameda shells were collected from an area extending to 200 m either side of the proposed outfall position. In the samples, numerous living and dead New Zealand screw shells Maoricolpus rosea were found. However, no living or dead Gunns screw shell Gazameda gunnii were found in the samples.

3.4.3 String Kelp Community
The giant string kelp is the predominant habitat-forming element of the marine community in the embayment where the Kingborough outlet is located. In this embayment, Macrocystis pyrifera forms an extensive and dense kelp forest and creates an important local ecosystem.
Giant string kelp or *Macrocystis* is found in Australia only in cool, exposed waters around Tasmania and from Cape Jaffa in South Australia (300 km southeast of Adelaide) to Walkerville in Victoria (near Wilsons Promontory). It is also found in cool waters in South Africa, South America and Pacific North America, often where there are nutrient rich waters from natural upwelling. *Macrocystis* is the longest marine plant in the world and is also one of the fastest growing.

*Macrocystis* forests are recognized for their spectacular underwater scenery, the unique habitat that they provide for a range of other marine plants and animals and their contribution to primary productivity that flows onto the associated biological community. Overall, giant string kelp provides a valued local ecosystem. It appears to require cool, nutrient-rich, agitated oceanic waters. There is concern that global warming is reducing the extent of *Macrocystis* forests at a worldwide scale, including in Tasmania.

The existing discharge is located among a stand of giant string kelp which is the densest *Macrocystis* forest in the Derwent estuary. Scientists consider that the discharge of nutrients (particularly nitrogen) from the existing outfall assists in the maintenance and density of the giant string kelp forest in Blackmans Bay. This is supported by macrocosm experiments on the effect of effluent on *Macrocystis* growth in California and observations of kelp forests near wastewater outfalls in California.

The seaweed-dominated community was documented along transects radiating from the existing outfall using a diver operated video camera. This method is used extensively on coral reefs and CEE has adapted the method to quantifying the biological characteristics of kelp dominated reefs in southern Australia.
**Kelp Community Composition in Relation to Water Depth**

The characteristics of the seaweed community change as depth increases, and possibly as effluent exposure decreases, with distance offshore (CEE, 2008). An extensive subtidal reef composed of boulders (around 0.5 to 1 m in size) extends for about 200 m offshore from the existing outfall. Beyond 200 m from shore, the substrate becomes a mixture of boulders and sand, with more limited substrate suitable for macro-algae. Figure 3-15 shows that *Macrocystis* and *Ecklonia* dominate the rocky seabed to a depth of approximately 8 m at a distance of approximately 200 m offshore.
3.4.4 Marine Biological Conditions Along Proposed Outfall Alignment
Marine biologists swam along the proposed alignment of the long outfall and recorded marine biological conditions on a video. A summary of the conditions is shown in Figure 3-15.

Figure 3-15. Marine Biological Condition on Long outfall Alignment
In the first 30 m of the alignment, which is across boulder reef, the dominant biota were encrusting coralline and non-coralline red algae, with scattered large brown algae and abundant Ulva sp. (sea-lettuce). Macrocystis (giant kelp) began to appear at around 15 m from the existing outfall, but was relatively sparse.

Between 30 and 50 m from the existing outfall, the amount of foliose red algae increased markedly. Ulva was still present, though in decreasing abundance. At 65 m from the outfall the brown alga Carpoglossum sp. began to appear amongst the large brown algae, at a similar abundance to Ecklonia radiata. Ulva was absent beyond 85 m from the outfall, while the abundance of the large brown algae (E. radiata, Carpoglossum sp. and Acrocarpia sp) and foliose red algae was higher than nearer to shore.

Beyond 30 m from the existing outfall, foliose red algae first appeared in low abundances, increasing with distance and depth. Encrusting red algae were still abundant under a dense cover of large brown algae such as Ecklonia radiata kelp and Acrocarpia sp.

Macrocystis sp. (giant string kelp), which had been relatively sparse from 15 m from the outfall, formed a substantial canopy at approximately 90 m from the outfall. Beneath the Macrocystis canopy at 90 m from the outfall, the benthic algal assemblage changed markedly. Foliose red algae increased in abundance relative to the large brown algae and Caulerpa trifaria (a green alga) began to appear. The Macrocystis bed extended to 150 m beyond the outfall, and the algae growing below it showed few changes with distance from the outfall or depth, except that the abundance of C. trifaria increased toward 150 m from the existing outfall.

Beyond 150 m from the outfall, Macrocystis became increasingly sparse. At 170 m distance another species of Caulerpa appeared in similar abundance to C. trifaria. By 195 m distance beyond the outfall, Macrocystis was very sparse while Ecklonia was the dominant brown algae on the seabed, with high abundances of encrusting and foliose red algae and Caulerpa spp. At around 200 m from the existing outfall and approximately 8 m depth, the seabed changes abruptly from a reef composed of boulders to first a sandy seabed with some boulders and then to a seabed of sand, shells and silt beyond 240 m.

As the seabed changed from one dominated by boulders to one dominated by soft sediment, the abundance of habitat suitable for benthic algae fell, so that by 220 m from the outfall, no more Macrocystis was present. The few boulders present between 200 and 240 m were covered with algae. On sand, however, almost all the algae seen, was unattached and drifting.

The sandy seabed beyond 240 m varied in composition from quite coarse sand and shells with some fine sediment, to fine sand and sediment. Areas of different sediment types were often quite localised and delineated. Areas of coarse sediment tend to form an undulating bed of sand ‘waves’ while finer sediment forms a flatter bottom.
Beyond 400 m from the outfall, apart from drift algae, some foliose algae and a balloon-like alga (*Gloiosaccion brownii*) were seen attached to shells (screwshells). Beyond 500 m in areas of fine sediment, scattered individuals of an Echiuran could be seen, their long proboscises extending over the sediment.

Similar patterns in the change in marine habitat with distance from shore were seen in transects extending offshore at 50 m and 100 m north and south of the outfall, with the difference that the effects of the outfall were less apparent in these transects.

The changes in marine habitat with distance along the offshore transect from the existing outfall are depicted in Table 3-4. This transect provides the strongest evidence of the adverse effects of the existing outfall on marine biota. As noted previously, the effects are limited to the zone close to the outfall where the dilution is low, and the extent of the zone of impact allows the desirable dilution for the new outfall to be established. The intent is to design the new outfall to provide sufficient initial dilution to avoid a zone of adverse impact.
Table 3-4. Changes in Marine Habitat Along Transect Extending Offshore From Existing Outfall

| Transect Section | 0-5 m | 5-10 m | 10-30 m | 30-50 m | 50-65 m | 65-75 m | 75-90 m | 90-100 m | 100-125 m | 125-140 m | 140-150 m | 150-160 m | 160-185 m | 185-200 m | 200-250 m | 250-600 m |
|------------------|------|------|--------|--------|--------|--------|--------|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Caulerpa trifaria | Y    | Y    | Y      |        |        |        |        |        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        |
| Ulva sp          |      |      |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |
| Caulerpa sp.     | Y    | Y    | Y      |        |        |        |        |        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        |
| Macrocystis pyrifera |    |      |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |
| Eklonia radiata  | Y    | Y    | Y      |        |        |        |        |        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        |
| Carpoglossum sp. |      |      |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |
| Acrocarpia sp.   | Y    | Y    | Y      |        |        |        |        |        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        |
| Encrusting Coralline |    |      |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |
| Encrusting Non-coralline |    |      |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |
| Erect Coralline  |      |      |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |
| Foliose          | Y    | Y    | Y      |        |        |        |        |        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        | Y        |
| Drift Algae      |      |      |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |
| Water Clarity    |      |      |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |
| Bottom Type (Boulders/Reef/Sand) |      |      |        |        |        |        |        |        |          |          |          |          |          |          |          |          |          |

<table>
<thead>
<tr>
<th>Algal Abundance</th>
<th>Colour Code</th>
<th>Bottom Type</th>
<th>Pattern</th>
<th>Water Clarity</th>
<th>Colour Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>Boulders/Reef</td>
<td>Poor-particulates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Abundance</td>
<td>Boulders and Sand</td>
<td>Fair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium Abundance</td>
<td>Sand and Silt</td>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Abundance</td>
<td></td>
<td>Good</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.4.5 Marine Community Habitats Parallel to Shore
A similar survey was made on a transect extending along the shore, as shown in Figure 3-16. The red/purple transect is a continuous 800 m long transect running 400 m north (red) and 400 m south (purple) of the outfall along the 4 m depth contour at Blackmans Bay – the start point (0 m) for the transect was approximately 30 m offshore from the existing outfall. This was the shallowest depth that a continuous transect could be placed – the seabed to the north of the outfall was too steep to place a transect in shallower water.

Reference transects were located 600 m north and south of the outfall (blue and green transects, respectively) and approximately 1 km south of the outfall (not shown on the map).

The characteristics of the marine biological communities along the transects were established from the video records to determine patterns in distribution of marine flora and fauna.

A total of 18 biological groups were readily identifiable on the video records. The biological groups that were particularly common within 400 m of the Blackman Bay outfall are shown in Figure 3-17 and were:

- *Ecklonia radiata* – the common kelp
- *Macrocystis pyrifera* – giant string kelp
- Foliose red algae – comprising predominantly *Plocamium* species
- Encrusting coralline algae – flat coral-like, pink algae that form a paint like crust on rocks
- Encrusting red alga – predominantly *Feldmania* a dark-red to purple coloured alga that forms leathery crust on rocks
The distribution patterns of *Macrocystis*, *Ecklonia*, foliose red algae, encrusting coralline algae and encrusting red alga along the transect are described in the following sections.
**Macrocystis**

As discussed above, *Macrocystis* requires cool, nitrogen rich water in well mixed marine environment. In Tasmania *Macrocystis* is most abundant on the south east ocean coastline. The stand of Macrocystis near the Blackman Bay outfall is the largest and healthiest in the Derwent estuary.

The figure shows the distribution of *Macrocystis* plants along the 4 m depth contour for 400 m north and south of the outfall. The first figure shows the abundance of plants along the seafloor rather than the amount of kelp canopy which is visible at the sea surface. This is considered to be a more reliable method of quantifying *Macrocystis*. The kelp canopy visible on the surface tends to vary considerably seasonally and annually, whereas the number of plants and their abundance near the seabed is more consistent over time.

*Figure 3-18. Macrocystis Distribution Along Transect*

*Macrocystis* increased in abundance from the outfall to a maximum at about 240 m south of the outfall and 180 m north of the outfall, beyond which the abundance decreased. The design intent is for the new outfall is to achieve sufficient initial dilution to avoid the zones of sparse growth (as occurs adjacent to the existing outfall) and also the zone of high stimulation.
**Ecklonia**

*Ecklonia* tolerates a very wide range of environmental conditions. It is found naturally in calm bays or along open ocean coastlines from southern Tasmania to Noosa in Queensland and Kalbarri in Western Australia.

*Ecklonia* has been recorded growing close to wastewater discharges in Devonport, Burnie, Barwon Heads, Mornington Peninsula, Apollo Bay, Coffs Harbour and Wollongong.

Figure 3-19 shows the distribution of *Ecklonia* along the 4 m depth contour for 400 m north and south of the outfall. The abundance of *Macrocystis* is also shown in the figure. The figure shows:

- *Ecklonia* is abundant in the locality of the outfall
- *Ecklonia* abundance reduces slightly with increasing distance to the north and south of the outfall
- High abundance of *Macrocystis* reduces the abundance of *Ecklonia* between 120 and 280 m south of the outfall (blue circle)

![Figure 3-19. Ecklonia and Macrocystis Distribution Along Transect](image)

The design intent is for the new outfall is to achieve sufficient initial dilution to avoid a zone of stimulation of Ecklonia (as occurs adjacent to the existing outfall).
Red Seaweeds
Red seaweeds in the region of the outfall were common components of the kelp (*Macrocystis* and *Ecklonia*) understorey. They comprise a mixture of *Plocamium* species as well as *Phacelocarpus*, *Ballia* and other species.

The survey identified a steady increase in the abundance of red seaweeds from the outfall southwards, with red seaweeds being common beyond 240 m south of the outfall. There was a reduction in the abundance of the red seaweeds under the abundant *Macrocystis* between 180 and 240 m south of the outfall.

Coralline Encrusting Algae
Coralline encrusting algae comprise a wide range of red algal species. It is not possible to distinguish most species without the aid of a microscope. As a group, coralline encrusting algae are common throughout Australian waters. The survey found that coralline encrusting algae were common close to the outfall, but least abundant beyond 340 m south.

Red Encrusting Algae
The red encrusting alga found in the region of the Blackmans Bay outfall is widespread along the exposed coastline of southern Australia where it is relatively sparsely distributed among kelp dominated communities.

3.4.6 Possible Effects of Effluent Discharge on Blackmans Bay Marine Biota
The area closest to the outfall (within 10 m) had very low cover of large, foliose algae. The benthic algal assemblage there was dominated by encrusting coralline and non-coralline red algae, with sparsely scattered individuals of *Ulva* sp, *E. radiata*, and *Acrocarpia* sp. This may be due to the effect of high exposure to effluent constituents including freshwater and ammonia, high organic load and reduced light due to turbidity.

*Ulva* was sparse from 10 m and 30 m from the outfall, but relatively abundant to approximately 80 m from the outfall. The low abundance within 30 m and high abundance immediately offshore from the outfall is likely to be related to the outfall discharge (low dilution).

*Macrocystis* was absent to sparse within 30 m from the outfall. Beyond 30 m, elevated nutrient levels (particularly nitrogen) in combination with the seabed composition and depth range provide suitable conditions for stimulated growth of *Macrocystis* in the bay where the outfall is located compared to other locations in the Derwent estuary. These conditions appear to be particularly favourable from 160 m to 280 m south of the outfall.

*Ecklonia* was present and abundant around the outfall in general. In contrast, red seaweeds have low abundance close to the outfall but increased in abundance away from the outfall to approximately 340 m south.
3.4.7 Implications of Marine Biological Monitoring for Discharge

The marine biological studies found that:

- The giant string kelp is the predominant habitat forming element of the marine community in the embayment where the Kingborough outlet is located.
- *Macrocystis* forests are recognized for their spectacular underwater scenery, unique habitat that they provide for a range of other marine plants and animals and their primary productivity that flows onto the associated biological community.
- There is concern that global warming is reducing the extent of *Macrocystis* forests on a worldwide scale, including in Tasmania.
- Scientists consider that the discharge of nutrients (particularly nitrogen) from the existing Blackmans Bay outfall assists in the maintenance and density of the giant string kelp forest in Blackmans Bay.
- There is some indication that high concentrations of effluent may negatively affect the growth of *Macrocystis* (within 80 m of the existing outfall).
- However, the distribution of *Macrocystis* indicates that the positive effect of the nutrients in the discharge on this species and the associated marine biological community may extend from 80 m to as far as 320 m north and 340 m south of the outfall.

The implications of the findings for the design and operation of the future outfall are:

- There is a zone near the existing outfall with low dilution in which the elevated concentrations of fresh water and nutrients causes significant changes in the marine biological communities. Such effects can be avoided by designing the new outfall to achieve an initial dilution of 50:1 or more.
- The outfall pipeline should be fitted with a series of valves that may be used to regulate the addition of some effluent to the embayment to maintain the healthy Macroystis forest.
- The growth of *Macrocystis* is highly seasonal with greatest growth in winter, and loss of upper foliage in summer; thus the effluent dosing schedule will be developed in parallel with the results of the kelp community monitoring program (see next section)
- The pipeline and concrete blocks will provide suitable substrate for the growth of kelps.
3.5 Socio-environmental Aspects

Risks relating to human health from the Blackmans Bay discharge were assessed recently (CEE, 2007). The beach monitoring data for Blackmans Bay and Kingston beach show consistently good water quality meeting the bathing water guidelines except for brief periods following heavy rainfall. Because surfers use the waters in Blackmans Bay immediately adjacent to the existing outlet, the findings of the health risk assessment show *high risk* for the existing outlet. The long outfall will reduce this to *low risk*.

The cost of the long outfall is estimated to be $2.4 million, which is well within the finding capacity of the Kingborough Council and will not have a significant effect on affordability of sewerage rates.

The effluent field will not be visible, even during calm conditions. The extension of the outfall will not have any effect of recreational use of the estuary (other than the beneficial impact on surfer health, as noted above) or fishing.

3.6 Alternative Outfall Sites

The proposal is to replace the existing outfall, which is on the coast of the estuary immediately below the existing Blackmans Bay treatment plant.

In planning the outfall extension, consideration was given to alternative locations for the long outfall. The factors considered in this assessment were:

- The effluent comes from Blackmans Bay WWTP which will not change location; hence the outfall must be near the WWTP;
- There is an existing pipeline down the cliff face and any change in outfall location will require a new pipeline to be constructed;
- It is desirable to keep the outfall in Blackmans Bay, so that nutrients can be supplied from the outfall to maintain the string kelp;
- Outfall sites to the north face residential development, a new pipeline down the cliff and a more difficult coastal strip for construction;
- Outfall sites to the south are feasible, but require a new pipeline down the cliff and a rockier shoreline and offshore zone.

From these considerations, the best location for the long outfall is considered to be adjacent to the existing outfall in Blackmans Bay. There is no benefit, but additional cost, in relocating the outfall to another location on the Derwent estuary. It would not be acceptable, from an environmental perspective, to relocate the outfall to North West Bay.

The proposal involves an extension of the outfall, so that the discharge location is not next to shore but in deeper waters well away from the shore, enabling better dilution of the effluent and reducing the environmental and health risks of effluent discharge.
4 POTENTIAL EFFECTS AND THEIR MANAGEMENT

Construction and Operations Phases

This section described potential environmental effects from the construction and operation of the long outfall, and measured to avoid, minimise or mitigate these effects. The potential issues are discussed in sequence, with impacts for construction and operations addressed in each section.

4.1 Air Emissions

During construction there will be relatively minor discharges of combustion gases from the equipment used to fabricate, tow and install the outfall and the connection chamber.

For operations, the outfall operates by gravity and no power is needed. There will be no discharges from the outfall to the atmosphere.

As noted above, additional odour controls have recently been installed at the Blackmans Bay treatment plant to reduce the level of odours at nearby residences. When the plant is augmented to handle higher flows and upgraded to improve the effluent quality, stringent controls on odour release will be incorporated as part of the upgrade, so that there will not be a long term odour problem in the vicinity of the plant.

4.2 Liquid Waste

Construction of the outfall will not produce any liquid waste.

The operation of the long outfall will be the same as for the existing short outfall, so the rate of effluent discharge through the long outfall will be the same as would occur with the short existing outfall.

The characteristics of the existing effluent discharge are listed in Tables 3-2 and 3-3. As noted above, the Blackmans Bay WWTP is to be upgraded in the future to reduce ammonia and total nitrogen concentrations in the effluent and to comply with more stringent Tasmanian guidelines for discharge to the marine environment (DPIWE, 2004). The guidelines apply to effluent discharged through the existing and long outfalls. The plant upgrade is, however, a separate project and not part of the outfall extension.

The current emission limits for Blackmans Bay effluent are shown in Table 4-1 and compared to the concentrations in the current effluent. The suspended solids and BOD levels are generally in compliance. Thermotolerant coliform levels are mostly in compliance, but occasionally elevated, when there are power failures and loss of the chlorination system. Power failures at the plant occur about 4 times per year, lasting about an hour each time. The flow continues to flow by gravity through the treatment plant by during power failures. The quality of the effluent gradually reduces over a period of about 2 hours, except there is no disinfection when there is no power.
### Table 4-1. Effluent Quality from Blackmans Bay WWTP

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Emission Limit</th>
<th>Effluent (90 %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspended Solids</td>
<td>60 mg/L</td>
<td>20 mg/L</td>
</tr>
<tr>
<td>BOD</td>
<td>40 mg/L</td>
<td>30 mg/L</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>10 mg/L</td>
<td>8 mg/L</td>
</tr>
<tr>
<td>Thermo coliforms</td>
<td>1000 org/100 mL</td>
<td>900 org/100mL</td>
</tr>
<tr>
<td>Range, pH</td>
<td>6.5 – 8.5</td>
<td>6.5 to 8.5</td>
</tr>
</tbody>
</table>

There are no significant industrial sources of waste water in the Blackmans Bay catchment and although there are some commercial sources, the treated effluent has low concentrations of metals and pesticides. Analyses of metals and pesticides in the effluent shows that metal and pesticide levels are very low (see June 2008 example listed in Table 3-3).

#### 4.3 Groundwater

The outfall will be constructed almost entirely underwater, with only minor construction on the beach adjacent to the high tide line. There will be no effects on groundwater during construction or operations.

#### 4.4 Noise Emission

The outfall operates by gravity and no power is needed in operation.

During construction there will be relatively minor noise from the equipment used to fabricate, tow and install the outfall and the connection chamber. The cliff and the distance will protect residences from unacceptable noise. Working hours are limited to 7.30 am to 7.30 pm from Monday to Friday, and 8 am to 5 pm on Saturday. There will be no work on Sundays or public holidays.

During operations, there may be a faint noise from air discharging from the air vent, but it will not be noticeable more than about 1 m from the vent.

#### 4.5 Solid and Controlled Waste

Construction and operation of the outfall will not produce any solid or controlled waste. The only anticipated excess construction material will be minor offcuts of HDPE that can be recycled.

#### 4.6 Dangerous Goods

Construction and operation of the outfall will not involve or produce any dangerous goods. The HDPE pipes are welded together by heating the faces of adjacent pipes and pushing them together in a controlled manner.
4.7 Biodiversity and Conservation

The proposal clearly has implications for biodiversity and conservation. The marine environment is described in detail in an earlier chapter of the DPEMP.

No rare or threatened species were identified in the marine biological studies that could be affected by the proposal.

The rate of effluent discharge through the long outfall will be the same as for a short outfall; however, there will be a substantial improvement in environmental outcomes because the long outfall will have a diffuser at a depth of 13 m which will produce a minimum initial dilution of 100:1 to 130:1. This dilution will avoid the adverse impacts associated with the discharge through the existing outfall, which are related to a low initial dilution (CEE, 2007).

The total area involved in construction of the long outfall is approximately 0.7 ha. After construction, the total area covered by permanent facilities will be 5 m$^2$ for the connection chamber and 300 m$^2$ for the pipeline.

A risk assessment was conducted of potential impacts and mitigation measures were developed as listed in Table 4-2.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Risk</th>
<th>Management Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion – construction</td>
<td>Turbidity plume</td>
<td>Filter any turbid water through beach sand</td>
</tr>
<tr>
<td>Erosion – long term</td>
<td>Loss of beach/cliff</td>
<td>Trench to be backfilled with rock and concrete. Connection structure to be secured in concrete.</td>
</tr>
<tr>
<td>Leakage of fuel/oils</td>
<td>Slick, damage to aquatic biota</td>
<td>No fuel stored on site. Refuel vessels in harbour. Drip trays under oil sources.</td>
</tr>
<tr>
<td>Chemical storage</td>
<td>Spill, toxic effect on aquatic biota</td>
<td>No liquid chemicals stored at the site.</td>
</tr>
<tr>
<td>Marine pests</td>
<td>Introduction or spread of marine pests</td>
<td>Only local vessels being used. Inspect vessels and pipe strings before towing to site. All standard quarantine procedures to limit marine pest movement apply.</td>
</tr>
<tr>
<td>Blasting</td>
<td>Damage to fish and larger marine species</td>
<td>Use alternative excavation methods. Move boulders using air bags and vessel. Blasting is a last resort. Controlled blasting underwater in accordance with Australian Standard, with monitoring of restricted zone prior to any blasting. Limited period of blasting</td>
</tr>
<tr>
<td>Damage to kelp</td>
<td>Damage by vessel or towing pipeline into position</td>
<td>Select alignment with least kelp. Tie kelp back from alignment. Trim surface canopy to avoid root damage.</td>
</tr>
</tbody>
</table>
Blasting is limited and will be carefully controlled. Overall, it is anticipated there will be about 6 blasting events near on the shore over a period of 2 weeks and about 3 blasting events offshore. All blasting will be carried out in accordance with the requirements of AS 2187.2. No offshore blasting will occur if dolphins or whales are observed to be within 1 km of the site. Blasting will be monitored to ensure there is no significant or long term increase in turbidity.

The outfall alignment and the construction procedure have been planned to minimise damage to string kelp and other marine flora and fauna. A passage through the kelp for the pipeline will be established by tying kelp back from the route to the extent feasible. Otherwise, the top growth of the kelp will be trimmed, protecting the holdfasts and stems for later re-growth.

Procedures to avoid oil and fuel spills (and steps to manage any spill that may occur) will be set out in the EPP following the proposals set out in “Environmental Best Practice Guidelines 2 – Construction Practices for Waterways and Wetlands”.

The pipeline will be brought to site and installed in four strings each 144 m long. Thus there will be only a limited period when vessels are operating.

4.8 Marine and Coastal

Previous experience in studies of the ecological effects of treated wastewater discharges to the marine environment and the findings of the State of the Derwent Estuary Study (Green and Coughanowr, 2003) are summarised below.

“The Derwent is affected by a number of environmental issues, in particular:

1. Severe contamination of water, sediments and biota with heavy metals, derived predominantly from historical industrial sources;
2. Widespread ecological damage associated with introduced marine pests, particularly the Northern Pacific Seastar;
3. Historical losses and continuing threats to wetlands, tidal flats, seagrasses and macro algae;
4. Intermittent contamination of recreational waters by faecal bacteria associated with stormwater and sewage discharges;
5. Depressed dissolved oxygen levels and organic enrichment of sediments in the upper and middle estuary associated with both pulp mill discharges and natural seasonal variations; and
6. Altered river flow regimes and blocked fish migration routes due to hydro-power development.”

Based on these findings and a workshop involving CEE and Tasmanian environmental scientists and environmental engineers, the key environmental issues identified for the Kingborough discharges were:

1. Impact of effluent discharges on string kelp;
2. Impact of effluent discharges on intertidal marine biota;
3. Impact of effluent discharges on nearshore marine ecology;
4. Impact of organic constituents on dissolved oxygen;
5. Impact of microbiological discharges on recreational waters; and
Marine biological studies were conducted to establish the impacts or effects of effluent discharges on string kelp, intertidal biota and nearshore benthic biota.

An environmental risk assessment (ERA) has been completed for the Blackmans Bay and Taroona effluent discharges into the Derwent estuary (CEE, 2007). The ERA comprised an ecological risk assessment of the effects of the discharges on marine ecosystems, and a health risk assessment of the effects on public health.

Comprehensive marine biological studies were undertaken of the subtidal biota in Blackmans Bay, and at reference sites north, south and offshore of the Bay. Giant string kelp is an important component of the marine ecosystem in Blackmans bay, and it was established that the effects of the discharge from the existing outfall on the string kelp are an inhibition within 30 m of the outlet, a stimulation from 100 m to 250 m from the outlet and no detectable effect thereafter.

The effects on other marine biota at Blackmans Bay revealed that the effect of the discharge may extend as far as 340 m south and 320 m north of the outlet.

The potential toxicity of Blackmans Bay sewage treatment plant effluent was identified as a potential ecological risk. Thus toxicity tests (or bioassays) were carried out using *Nitzschia*, a common diatom that occurs widely in the marine environment in Tasmania, and *Hormosira*, a common brown seaweed that is found along the Tasmanian coastline including parts of the Derwent estuary.

In summary, the toxicity test results indicate a potential environmental risk with the existing treatment and effluent discharge arrangements. The spatial extent of the risk can be judged from the exposure-duration curves, and would extend potentially up to 200 m north and south of the existing Blackmans Bay outfall.

The toxicity was attributed to ammonia and the effect of fresh water in the marine environment – up to a dilution of about 50:1.

### 4.9 Management Strategy Adopted by Kingborough Council

The strategy to manage the risks that has been adopted by Kingborough Council is as follows:

1. Extend the Blackmans Bay outfall, as that would provide immediate relief to the stressed marine ecosystems in the intertidal and shallow nearshore waters, and ensure the string kelp was protected against an over dose of nutrients or concentrated contaminants from the treatment plant. The extension of the Blackmans Bay outfall also would minimise the potential public health impacts, as the discharge would be well offshore from the zone used by the surfers.

2. Upgrade the Blackmans Bay STP to meet the DPIWE emission limit guidelines for new and upgraded treatment plants. It is recommended that, in summer, the ammonia and total nitrogen levels in the effluent must comply with the guidelines; in winter higher levels of ammonia and total nitrogen should be permitted in the effluent as background levels in the lower estuary are high in winter and spring due to the input in ocean currents. Despite the 75 per cent increase in population, there will be a reduction in annual solids, BOD, ammonia and nitrogen loads to the estuary, as shown in Table 4-3.
Table 4-3. Present and Future Nitrogen Loads to Derwent (t/yr)

<table>
<thead>
<tr>
<th>Kingborough Council Treatment Plants</th>
<th>Susp. Solids</th>
<th>BOD</th>
<th>Ammonia</th>
<th>Total N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge to Derwent – 2005</td>
<td>88</td>
<td>75</td>
<td>157</td>
<td>186</td>
</tr>
<tr>
<td>Future load in 2030</td>
<td>66</td>
<td>66</td>
<td>82</td>
<td>134</td>
</tr>
</tbody>
</table>

Phosphorus levels will decline with the reduction in BOD and suspended solids levels. It is considered that phosphorus is not a limiting nutrient in the marine environment of the Derwent estuary and hence there is no need for very low phosphorus levels in the effluent. If this assessment changes, it would be straightforward to reduce phosphorus in the effluent from the upgraded plant by chemical precipitation.

4.10 CSIRO Regional Model

The Environmental Modelling Group of the CSIRO Division of Marine Research was engaged to model the regional dispersion of effluent from the Blackmans Bay outfall. The model of the Derwent Estuary that was used by the CSIRO is a three dimensional non-linear, variable density, hydrodynamic model which is nested within a large scale regional model of Storm Bay and the Southern Ocean.

The model is driven by the fresh water inflows, winds, atmospheric pressure gradients and tides. Because of the efficient arrangement of model calculations, one full 3-D simulation of currents, salinity, sedimentation and tracking of tracers can be completed in about 3 days. The model has been shown to reproduce the current and salinity patterns in the Derwent Estuary very well (ref. M Herzfeld et al, 2004).

The model predictions show the regional dispersion of effluent from both the existing and proposed outfalls – the difference being that the concentrations are lower within 2 km of the long outfall (see Figure 3-5).

The CSIRO model was used to simulate the dispersal of effluent from the Blackmans Bay outlet by releasing a particle tracer in the model cell across the outlet. As the release is into a surface cell of about 1,600 m$^3$, there is an immediate initial dilution. The model showed both southward and northward transport of diluted effluent, with a net transport to the north, where the very dilute effluent gradually spread through the waters of the estuary between Hobart and Clarence, and then was flushed out to sea in the general movement of estuary waters.

Figure 4-1 shows that within 1 km of the outfalls, the dilution averages about 500:1.
Figure 4-1. Predicted Effluent Dilution
There is a net movement of the diluted effluent to the north (this will be the same for the existing outfall and the long outfall) reflecting the general estuarine circulation of a net inflow on the western shore and a net outflow on the eastern shore.

Within about 3 km from the discharge, the predicted dilution exceeds 1,000:1 (at about 2 days after discharge). After a dilution of 100:1, the contribution due to the effluent is equal to or less than background concentrations while after a dilution of 1,000:1, the contribution due to the effluent is less than the natural variations in background concentrations and hence no effects of the discharge can be detected.

A video of the dispersion pattern for a two week period of actual currents and winds has been developed and installed on the Kingborough Council web site.

### 4.11 Toxicity Tests

The potential toxicity of the Blackmans Bay effluent was identified as a possible ecological risk. Thus toxicity tests (or bioassays) were carried out. Test biota or life stages (such as developing eggs) were placed in a series of effluent dilutions for a set time. Test biota also were placed in control solutions containing no effluent. After the period of the test, the number of individuals in the test dilutions that have responded differently from the control preparations are counted and the ecotoxicity (as a dilution) is calculated.

Only a small number of marine biota (adults or life-stages) are readily available for acute and chronic tests or that are relevant to the Tasmanian marine environment. Given the importance of algae in the marine community at Blackmans Bay, and the potential for toxic effects of ammonia, the two specific tests chosen were:

1. **Nitzschia cell division** - This test is a very useful and sensitive test which provides information on both growth inhibition and growth stimulation. *Nitzschia* is a common diatom that occurs widely in the marine environment including in Tasmania. The tests have been widely used so that there is sufficient information for results to be assessed for the effects of ammonia in the effluent as both a toxicant and growth stimulant. Ecotox Services Australasia carried out this test.

2. **Hormosira germination test** - *Hormosira* is a common brown seaweed that is found along the Tasmanian coastline including parts of the Derwent Estuary. It was found to be sensitive to sewage effluent during tests carried out for the CSIRO Boags Rocks environmental study. CSIRO carried out this test.

### Nitzschia Test Results

The tests showed that the growth rate of *Nitzschia* was inhibited only in the preparation containing 100 per cent effluent. The preparation containing 20 per cent effluent had no effect on the growth (either inhibition or stimulation) of *Nitzschia* relative to the control preparations after 72 hours of exposure. Statistical tests estimated that the concentration at which growth was inhibited to 50 per cent of the control preparation after 72 hours was 59 per cent effluent (corresponding to a dilution of only 2:1).
The test results were assessed against known response characteristics (previous tests by CSIRO) for the contribution of ammonia to the observed growth inhibition response. CSIRO concluded that ammonia was the toxicant responsible for the inhibition of growth. However, the effluent was significantly less toxic to *Nitzschia* than would be expected for an effluent with 20 mg/L ammonia.

The growth rates of *Nitzschia* in the preparations containing 20 per cent effluent and less were greater than most of the control preparations. Hence, it is possible that effluent concentrations between 20 per cent (the NOEC) and 59 per cent could stimulate *Nitzschia* growth. Overall, the toxicity tests showed that Blackmans Bay effluent had very low chronic toxicity to *Nitzschia*.

**Hormosira Test Results**

The tests showed that the rate of germination of the intertidal seaweed *Hormosira banksii* was reduced in effluent at 100 per cent, 20 per cent and 5 per cent levels. The rate of cell division was unaffected by 2 per cent effluent (NOEC = 2 % effluent). Hence, Blackmans Bay effluent showed moderate chronic toxicity to the macroalgal test, with an effluent dilution 1:50 required for a non-toxic response.

**Interpretation of Toxicity Results**

It is apparent that the existing outfall, with an initial dilution of only 4:1, is likely to be surrounded by a small zone in which there is a potentially toxic effect. The marine biological studies confirm that, indeed, there is a zone of impact around the existing outfall.

On the other hand, the long outfall will provide an initial dilution exceeding 100:1 which is sufficient to avoid any toxic effects. Thus the high dilution provided by the long outfall will eliminate the toxicity risk.

**Extent of Toxic Risk with Existing Outfall**

Water quality sampling was carried out near the existing outfall to establish the distance to which elevated ammonia levels could extend. The results of the chemical analyses for ammonia, total nitrogen and total phosphorus are shown in Figure 4-2. The median ammonia concentration in the discharge is 34 mg/L, and this would reduce to below 0.7 mg/L at about 200 m from shore. Thus the spatial extent of the risk of a toxic impact is judged to extend potentially up to 200 m offshore from the existing Blackmans Bay outfall.

Dye studies were conducted to assess the extent of the toxicity risk parallel to the coast. The results showed that the 50:1 dilution contour was generally at 100 to 250 m from the existing outfall.

In comparison, the proposed outfall with diffuser will achieve a 100:1 initial dilution and hence there will not be any detectible zone of toxic effect in the future. The results of the modelling and toxicity assessment show there will be no effects on the Tinderbox Marine nature Reserve, which is 4 km away.
4.12 Commercial Fish and Aquaculture

The Blackmans Bay outfall does not appear to have any effect on recreational or commercial fishing. Recreational angling for squid and fish such as flathead, whiting and garfish is popular, though generally limited to wharves and jetties. The use of single nets for recreational fishing is permitted between the Iron Pot and Battery Point in daylight hours.

There is little commercial fishing in the Derwent Estuary. The Derwent Estuary upstream of the Iron Pot is a nominated Shark Nursery Area, and longlines, mullet nets and combined graball nets are prohibited in this area. There are historically elevated metal levels in the estuary and hence commercial fishing is not permitted. There is no aquaculture within 5 km of the outfall zone.

4.13 Effects on Geomorphology

A search of significant local geomorphology sites was undertaken, and the proposal will not affect any of them. The cliff and beach of Blackmans Bay are significant local landforms and outfall construction has been devised to minimise effects by:

- Burying the outfall in a trench across the shore and near-shore zones,
- Using local rock to face the top of the reinstated trench
- Selection of alignment to minimise length of bedrock and kelp;
- Where possible mechanically move rocks and minimise blasting;
- Designing replacement offshore pipeline so it will not be visible and the beach and shore area will look the same after construction as before.
4.14 Greenhouse and Ozone
During construction there will be relatively minor use of fuel and hence a consequent discharge of greenhouse gases from the equipment used to fabricate, tow and install the outfall and the connection chamber.

The outfall operates by gravity and hence has no energy input. The rate of effluent discharge through the long outfall will be the same as occurs now, and will take place in the future through the existing outfall.

Discharges of nutrients to the estuary can, in theory, stimulate some minor (but undetectable) increase in algae production which will take up a small amount of carbon dioxide. Most of this carbon will be recycled in subsequent cycles of predation and decay, so the net effect (involving incorporation of solid carbon enriched detritus in the seabed) is expected to be very minor.

It may be appropriate to note that the alternative option of reuse of the effluent on Bruny Island would require a substantial input of energy.

4.15 Heritage
A search of the Aboriginal heritage issues in cooperation with the Tasmanian Heritage Office established that there are no registered sites in the beach and seabed affected by the proposal and no Aboriginal heritage concerns.

A search at the Tasmanian Heritage Office and the Kingborough Heritage Register confirmed that there are no European heritage sites affected by the proposal.

The Maritime Heritage Officer at Tasmania Parks and Wildlife Service advised that there are no known maritime heritage wrecks or sites in the vicinity of the proposed extension of the Blackman’s Bay outfall. A video of the entire alignment has been made and no wrecks or marine heritage items have been encountered.

In the event that any Aboriginal, European or maritime heritage items are discovered, then work will cease immediately and the appropriate authorities will be notified so that a proper assessment of the find can be made and an action plan developed before proceeding.

There is a registered geo-heritage site on the shore of the lower Derwent Estuary about 1.5 km to the south of the construction site (Fossil Cove Drive, Blackmans Bay; on Register of National Estate). This is a rock shelf containing fossils; it is well away from the site and will not be affected in any way by the proposal.

4.16 Land Use and Development
As noted in Chapter 3 of the DPEMP, the Blackmans Bay WWTP is to be expanded to handle the increased flows from population growth in Kingborough. Theoretically it is possible that the increased flows could be discharged through the existing outfall, although this is not desirable from an environmental perspective.
Thus the construction of the long outfall at Blackmans Bay will support the development of the municipality of Kingborough in accordance with development plans approved by the Council.

An application has been lodged with Crown Lands for permission to construct the connection chamber and to replace the outfall across the coastal reserve.

The Tinderbox marine reserve is 4 km to the south of the site and will not be affected by the proposal.

4.17 Visual
The proposed outfall will be buried across the shore line and to a distance of about 30 m from shore, and hence will not be visible. The trench will be backfilled with local natural materials to make the appearance the same as existing conditions.

The proposed connection structure will be at the foot of the cliff and not visible from the top of the cliff. It will be coloured to match the cliff and hence should be difficult to discern from the sea.

The diluted effluent field will not be visible, even under calm conditions.

4.18 Socio-economic
Socio-economic aspects are addressed in Section 3.3. At present, surfers use the existing outfall as a path to enter the water. This brings them into direct contact with the effluent at a low dilution, although the effluent is disinfected. The proposal will eliminate this contact and hence improve the public health situation for the few surfers that swim (briefly) at the existing outfall.

The cost of the long outfall is estimated to be $2.4 million, which is well within the funding capacity of the Kingborough Council and will not have a significant effect on affordability of sewerage rates.

The extension of the outfall will not have any effect of recreational use of the estuary (other than the beneficial impact on surfer health, as noted above) or fishing.
4.19 Health and Safety
The beach monitoring data for Taroona, Kingston Beach and Blackmans Bay shows consistently good water quality, meeting the bathing water guidelines, except for brief periods following heavy rainfall.

This issue is recognised in the information brochure released in February 2006 by the Derwent Estuary Program entitled *Swimming in the Derwent*. The brochure confirms the good water quality at Taroona and Blackmans Bay beaches and advises that “swimming is not recommended in the Derwent for several days after heavy rain and never in the vicinity of stormwater drains”.

As the nearest beach is almost 1 km from the existing outfall, and the thermotolerant coliform level will be reduced from 900 org/100mL to less than 3 org/100 mL by the combination of dilution and natural die-off, it is not expected that there would be any significant contribution from the existing outfall to beach levels of coliforms. With the long outfall, the contribution will be even smaller.

The median and 90 percentile faecal coliform and enterococci levels in effluent from the Blackmans Bay plant are shown in Table 4-4 before and after initial dilution. These results indicate that bathing directly in the effluent field could be a potential risk. It is noted that at Blackmans Bay surfers access the water via the outlet pipeline and are thus exposed to effluent immediately after discharge.

After the additional dilution provided by the proposed long outfall, the faecal coliform and enterococci levels in the effluent field will meet bathing water standards and hence remove the local health risk from surfing near the outfall.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Blackmans Bay</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 % faecal coliforms</td>
<td>100 25</td>
</tr>
<tr>
<td>90 % faecal coliforms</td>
<td>900 225</td>
</tr>
<tr>
<td>50 % enterococci</td>
<td>255 64</td>
</tr>
<tr>
<td>90 % enterococci</td>
<td>4700 1200</td>
</tr>
</tbody>
</table>

Guideline limits are 200 org/100 mL for faecal coliforms and 35 cfu/100 mL for enterococci
4.20 Hazard Analysis and Risk
There are hazards and risks during the construction phase which will be managed via the health and safety program of the Contractor.

In the interest of safety, public access to the shore and within 500 m offshore will be restricted during construction. There will be no restrictions after the long outfall has been commissioned, apart from a ‘no anchor’ zone within 200 m of the diffuser.

All construction will be carried out in accordance with an Environmental Project Plan prepared by the contractor and approved by the Council. The EPP must include all commitments made in the DPEMP and all additional conditions imposed by planning and environmental agencies.

The requirements of Maritime Safety Tasmania (MAST) will include:
- Notification to public (by MAST) of construction period and activities, including exclusion zone;
- Exclusion zone of 500 m offshore to be marked by buoys and monitored by contractor at all times during construction;
- Pipeline strings towed only during daylight hours and moored at night with lights each end and at 25 m intervals along the pipe string;
- Controlled blasting underwater in accordance with Australian Standard, with provisions for inspections prior to any blasting.

Blasting is limited and will be carefully controlled to avoid landslips. All blasting will be carried out in accordance with the requirements of AS 2187.2. The standard precautions will be taken to ensure there is no member of the public at risk during blasting operations.

After the outfall is in operation, the hazards and risks will be minimal, as the pipeline will have no moving parts and discharge high quality disinfected secondary effluent.

**Fire Risk**
The proposal does not involve any significant fire risk. Appropriate precautions will be undertaken during the construction stage, in accordance with the Contractor’s EMP.

**Infrastructure and Off-site**
Socio-economic aspects are addressed in Section 2.3. There will be an off-site pipe fabrication yard at a slipway that will be in use for about a month or so. This yard is selected by and under the control of the installation contractor. Work at the fabrication yard will be carried out under the requirements of the EMP developed by the Contractor.

**Environmental Management Systems**
The Contractor will be required to have an EMP that meets statutory requirements and the additional requirements of the Kingborough Council.
Particular emphasis will be given to:

- Protection of string kelp;
- Protection of marine biota;
- Avoidance of fuel and oil spills;
- Protection of the cliff;
- Procedures to avoid introduction of marine pests.

4.21 Cumulative and Interactive

The combined discharge from the Blackmans Bay and Taroona plants of 4.5 ML/d (0.05 m³/s) is approximately 8 per cent of the total discharge to the estuary from wastewater treatment plants, but only 0.05 per cent of the fresh water input to the estuary. Thus, while there may be a localised effect due to the fresh water input, the treatment plant discharges do not have a significant influence on the currents or salinity distribution in the estuary.

Treatment plant discharges, urban runoff and industries are significant sources of nutrients, suspended solids and faecal coliforms, as indicated in Table 4-5. There is substantial contamination of the estuary and filter feeding organisms as a result of historical discharges of metals to the estuary from mining and metal processing.

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Wastewater t/yr</th>
<th>Stormwater t/yr</th>
<th>Industry t/yr</th>
<th>Kingborough proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nitrogen</td>
<td>444</td>
<td>84</td>
<td>58</td>
<td>5 %</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>148</td>
<td>10</td>
<td>1</td>
<td>10 %</td>
</tr>
<tr>
<td>Zinc</td>
<td>&lt; 1</td>
<td>7</td>
<td>130</td>
<td>&lt; 0.001 %</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>350</td>
<td>3620</td>
<td>1100</td>
<td>5 %</td>
</tr>
<tr>
<td>Faecal coliforms</td>
<td>$1.2 \times 10^{13}$</td>
<td>$4.5 \times 10^{15}$</td>
<td>-</td>
<td>0.01 %</td>
</tr>
</tbody>
</table>

Source: State of the Derwent Estuary, 2003 and Kingborough monitoring data

As shown in Table 4-5, the Blackmans Bay WWTP is a significant source of nutrients and this will be managed by upgrading treatment at the plant in the future.
5 MONITORING AND REVIEW

The monitoring program has four components:

1. Effluent quality monitoring, to ensure there is effective treatment and disinfection, and also to confirm that there are not elevated levels of contaminants such as metals and pesticides in the effluent;

2. Infauna monitoring, to examine the effects of the new discharge location on animals living in the sediments near the outfall;

3. Sediment monitoring, to check particle size, total organic carbon, redox potential and metal content.

4. String kelp monitoring, to confirm there are not adverse effects from construction or moving the source of nutrients, and to provide a basis for optimising the operation of the three inshore discharge ports in the outfall;

5. Algal monitoring, to document the recovery from the existing discharge, within the zone extending about 300 m of the existing outfall.

5.1 Effluent Monitoring

The effluent monitoring program will involve:

- Weekly sampling and analysis for suspended solids, BOD, ammonia, total phosphorus, nitrate, total nitrogen, thermotolerant coliforms, enterococci and pH;
- Six monthly sampling of metals and pesticides – one set after winter and another after summer;
- Residual chlorine – monitored daily but reported monthly;
- Annual bioassay using the intertidal seaweed *Hormosira banksii*.

5.2 Infauna Monitoring

As discussed above, the effect of the effluent discharge may be apparent near the diffuser on the composition of the infauna community. The existing monitoring data have shown that there are substantial natural variations in the composition of the infauna assemblages from site to site over relatively small distances. Hence, the infauna monitoring program will document existing spatial and temporal variations in infauna communities in the vicinity of the discharge prior to the commencement of discharge so that potential impacts on infauna detected when the outfall is operating.

The infauna monitoring program will include both potential impact and reference sites as follows:

- Six monthly sampling of infauna at sites 10m, 50 m 100 m, 500 m and 1000 m either side of the proposed outfall location. These distances will provide for future comparisons of:
  - outfall effect (10 m sites)
  - nearfield effects (50 m sites)
  - marginal effects (100 m sites)
  - near reference sites (500 m sites) and
  - far reference sites (1,000 m sites).
Sampling of infauna will continue on a six monthly basis for three years after the outfall is commissioned. A report will be prepared following three years of monitoring which will:

- Describe the spatial and temporal variability of infaunal communities in the study area
- Determine the nature and extent of possible changes to the infaunal community and identify any positive or negative indicator species
- Propose the scope for ongoing monitoring or targeted investigations

5.3 Sediment Monitoring

The sediment monitoring program will record the following characteristics of sediments near the new diffuser over time: - particle size, total organic carbon, redox potential and metal content.

5.4 String Kelp Monitoring

The kelp community monitoring program will document the spatial and temporal variations in the kelp community in the vicinity of the existing discharge prior to the commencement of discharge (baseline conditions) so that the integrity and environmental value of existing *Macrocystis* forest in the embayment can be maintained.

The baseline monitoring program will include:

- Annual video baseline surveys of kelp communities along transects within embayment and at reference sites, using established methods.
- Develop strategy and schedule for dosing nutrients into embayment using valves on outfall pipeline through the *Macrocystis* forest.

The monitoring of kelp communities will continue for three years following commissioning of the outfall. A report will be prepared following three years of monitoring which will:

- Describe the spatial and temporal variability of kelp community along monitoring transects;
- Determine possible changes due to decreased nutrient load in the area;
- Discuss outcomes of nutrient dosing and recommendations for the future.

5.5 Monitoring of Recovery

A component of the marine biological monitoring program is to monitor changes in condition in the algal community near the existing outfall to determine the period for recovery from the adverse effects of the existing discharge. A video documentation and interpretation procedure will be used, along the 4 m depth contour to match the baseline monitoring.

The survey will be carried out 12 months after the long outfall is commissioned.
6 DECOMMISSIONING AND REHABILITATION

Sewerage facilities are critical community infrastructure that serves the community for long periods. The proposed outfall has a service life of 100 years. Hence it will not be decommissioned until around 2100.

At that time, the outfall pipeline on the seabed can be removed. In theory, the HDPE can be recovered and recycled.

The existing outfall is installed in a trench in the seabed. All visible sections will be removed as part of the construction of the long outfall.

7 COMMITMENTS

The following commitments are made to protect the environment and minimise adverse effects during construction and operation of the outfall.

<table>
<thead>
<tr>
<th>No</th>
<th>Commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Carry out all marine work under an agreed EMP</td>
</tr>
<tr>
<td>2</td>
<td>Not damage the cliff</td>
</tr>
<tr>
<td>3</td>
<td>Protect string kelp – and tie kelp back from working area</td>
</tr>
<tr>
<td>4</td>
<td>Protect marine biota</td>
</tr>
<tr>
<td>5</td>
<td>Monitor blasting and limit turbidity increment to less than 5 NTU at 80 m</td>
</tr>
<tr>
<td>6</td>
<td>Avoid fuel and oil spills – no fuel storage at the site;</td>
</tr>
<tr>
<td>7</td>
<td>Remove visible parts of existing outfall</td>
</tr>
<tr>
<td>8</td>
<td>Bury new pipeline across shoreline</td>
</tr>
<tr>
<td>9</td>
<td>Implement procedures to avoid transporting marine pests</td>
</tr>
<tr>
<td>10</td>
<td>Use local rock to face the top of the reinstated trench</td>
</tr>
<tr>
<td>11</td>
<td>No fires permitted</td>
</tr>
<tr>
<td>12</td>
<td>Colour connection structure to match cliff</td>
</tr>
<tr>
<td>13</td>
<td>Optimise the supply of nutrients to the kelp</td>
</tr>
<tr>
<td>14</td>
<td>Where possible mechanically move rocks and minimise blasting</td>
</tr>
<tr>
<td>15</td>
<td>Communicate progress and blasting period to local residents</td>
</tr>
<tr>
<td>16</td>
<td>Provide all relevant information on Council web site</td>
</tr>
<tr>
<td>17</td>
<td>Revegetate if any areas damaged</td>
</tr>
<tr>
<td>18</td>
<td>Restrict public assess to avoid accidents</td>
</tr>
<tr>
<td>19</td>
<td>Tow pipe strings only during daylight - as permitted by MAST</td>
</tr>
<tr>
<td>20</td>
<td>Limit working hours</td>
</tr>
<tr>
<td>21</td>
<td>Stop work if any heritage items found</td>
</tr>
<tr>
<td>22</td>
<td>Manage and minimise blasting</td>
</tr>
<tr>
<td>23</td>
<td>Maintain surveillance before and during blasting</td>
</tr>
<tr>
<td>24</td>
<td>Conduct monitoring program to verify performance of outfall</td>
</tr>
<tr>
<td>25</td>
<td>Conduct monitoring program on effluent quality and toxicity</td>
</tr>
<tr>
<td>26</td>
<td>Conduct monitoring program on infauna</td>
</tr>
<tr>
<td>27</td>
<td>Conduct monitoring program on kelp conditions and nutrient addition</td>
</tr>
<tr>
<td>28</td>
<td>Conduct monitoring program on recovery of algae</td>
</tr>
</tbody>
</table>
8 CONCLUSION

In summary, the proposal is to replace the existing outfall at Blackmans Bay with a long outfall extending 600 m offshore, including an 80 m long multi-port diffuser.

The proposal does not introduce any long outfalls into the Derwent Estuary. Instead, an existing outfall that has a local environmental impact will be replaced by a long outfall that achieves a much greater initial dilution (more than 100:1). At 100 m from the long outfall, the average initial dilution will be 180:1. The long outfall will provide a substantial improvement on the initial dilution produced by the existing outlet, which is only 4:1.

The proposed initial dilution with the long outfall is sufficient to ensure that there will be no adverse effects of the discharge on marine life. The toxicity and other adverse environmental effects resulting from the low dilution of the existing outlet will be eliminated.

The diffuser and construction procedure have been designed so that there will be minimal adverse effects on marine life and the effluent field will not be visible, even during calm conditions.

There will be no increase in discharge of effluent as a result of the long outfall. The existing above-ground pipeline down the cliff face will be retained and continue to be used. The long outfall will include three ports that can be adjusted to achieve the optimum addition of nutrients to maintain the health of the string kelp that grows prolifically in Blackmans Bay.

After the outfall is in operation, the hazards and risks will be minimal, as the pipeline will have no moving parts and will discharge high quality disinfected secondary effluent.

The proposed outfall will be buried across the shore line and to a distance of about 30 m from shore, and hence will not be visible. The trench will be backfilled with concrete and rock, and covered with local rock to make the appearance the same as existing conditions. The diluted effluent field will not be visible, even under calm conditions. The long outfall will not have any effect on recreational use of the estuary or fishing.

The proposal will improve the public health situation for the few surfers that use the existing outfall as a path to enter the sea.

The cost of the long outfall is estimated to be $2.4 million, which is well within the funding capacity of the Kingborough Council and will not have a significant effect on affordability of sewerage rates.

Based on the conclusions of the Environmental Risk Assessment, the proposed discharge is considered to be sustainable.
References


Macleaod and Helidoniotis, Report by TAFI, (2005)

9 APPENDICES

Appendix 1 DR-061105-001 New Blackmans Bay Outfall – Plan and Elevation
Appendix 4 DR-061105-003  New Blackmans Bay Outfall – De-aeration Chamber


Appendix 8 See Ecotox Services Australasia (2005), “Toxicity Assessment of Blackmans Bay STP Effluent” Test Report to CEE Consultants