3. WATER QUALITY CONSIDERATIONS AND THE DEVELOPMENT

3.1 Introduction

The proposed development consists of the following stages:

(a) Excavation of material from Bright Point and construction of the breakwater with this material. The material will be sieved so that only size classes above 7.5 mm will be included in the breakwater;

(b) Excavation of the marina basin and reclamation of foreshore land;

(c) Excavation of a shipping access channel through the reef;

(d) Flooding of the marina basin;

(e) Construction of hotel, marina, retail and recreational facilities on Bright Point and the Nelly Bay foreshore (partly on reclaimed land);

(f) Operation of marina;

(g) Operation of hotel facilities.

The construction phases (both marine and terrestrial) are expected to take up to two years to complete. The completed development is expected to house 187 boats in the marina and provide accommodation for 1000 in various classes of hotels.

The types of contaminants which could enter Nelly Bay from such a marina development have been reviewed by Riedel & Byrne (Public Environment Report, August 1988) under the headings; Antifouling coating; Oils, fuels and greases; Bilge water discharges; Nutrient releases and they have also discussed tidal exchange and wind mixing. While aspects of this report have been criticised by reviewers it still forms a basis on which to examine those parameters which need to be included in the monitoring programme. In addition possible construction stage sediment release has also aroused concern which must be addressed.

3.2 Sediments and Turbidity

It is widely accepted that elevated sediment loads can have adverse effects on coral reefs. Sediment affects corals directly by deposition on exposed coral tissues and indirectly by lowering of light intensity by water column turbidity. Hudson (1981) showed that a key factor in the growth and survival of the Carribean coral Montastrea annularis was water turbidity. Kuhlmann (1985) found a link between the density of coral cover and water clarity in the Ryukus Islands. A number of studies have quantified the effects of dredging and construction work on reefs (Bak, 1978; Ricard, 1981; Galzin, 1981; Amesbury, 1981; Marszalek, 1981; Dodge and Vaisnys, 1977) but because of the wide variations in natural turbidity levels different reefs can tolerate, transfer of conclusions from studies in one area to other reefs is difficult.

3.3 Nutrients

The levels of nutrients in Nelly Bay could increase due to the development in a number of ways. These include release of sewage from moored boats, increased sewerage plant discharges into Gustav Creek and runoff from landscaping activities. Nutrients may also be mobilized from fine sediment during its release in the construction phase. It is planned to treat sewerage plant effluent by land spraying which should minimize its entry into Nelly Bay but some runoff may occur. The effects of increased nutrient loadings on coral reefs are well documented qualitatively although quantitative data as to tolerance levels are still patchy. Effects include decreased coral growth and skeletal changes (particularly in skeletal density); increased macroalgal growth and overgrowth of coral leading to ecosystem change from coral reef to algal reef; increased phytoplankton growth leading to increased turbidity and decreased light levels and in extreme cases red tide phenomenon; changed community structure in terms of species diversity and species present. Such effects have been extensively documented from the Kaneohe Bay sewage diversion scheme studies (Smith, et al., 1981; Laws and Redalze, 1982; Maragos et al., 1985) as well as many other investigations.

There are now reasonably comprehensive data sets of nutrient levels in the Great Barrier Reef lagoon area and some of these are summarized in Table 1.

3.4 Petroleum Hydrocarbons

Marina activities will inevitably lead to small scale spills of diesel and four and two stroke petrols and this material may impinge on areas outside the marina. Most work on the effects of petroleum products on coral reefs have dealt with spillage of crude oil and heavy fuel oil and there is far less data available on the effects of the lighter fuel fractions in diesel and petrol especially the long term implications of chronic low level contamination.

A number of studies have shown accumulation of petroleum hydrocarbons in sediments and biota around marinas (Marcus & Stokes, 1985; Hansen et al., 1977; Voudrias & Smith, 1986).

Data available on the toxicity of petroleum hydrocarbons to coral is growing with wide variations in the tolerance of different species being found. Studies have examined effects on reproduction and growth rates (Loya and Rinkevich, 1980), photosynthetic activity (Cook and Krap, 1983), species response differences (Reimer, 1975), growth (Dodge et al., 1985), pathological responses (Peters et al., 1981) and overall response (Harrison et al., 1986). Studies on chronic exposure to low levels has shown reduced fertility and zooxanthellae numbers and tissue death (Rinkevich & Loya, 1977; Peters et al., 1981).

3.5 Sewage Bacteria

With any release of sewage from moored boats or sewerage treatment plant effluent entering Gustav Creek, will come the possibility of unacceptable bacterial levels on the marina beaches. While the more severe pathogenic microorganisms such as cholera and typhoid can be water borne, swimming in sewage contaminated waters is more likely to lead to problems of gastroenteritis and skin, eye and ear infections. Standards exist for primary contact recreational water (i.e. water sports and swimming) under the Queensland Clean Waters Act in terms of coliform levels while the whole subject of microbiological water quality criteria in Australia has been extensively reviewed by the Australian Water Resources Council (AWRC, 1985).

3.6 Anti-Fouling Coating Residues

Anti-fouling paints contain biocides which prevent the growth of biota on boat hulls but also slowly leach into the water column and can exert their biocidal activity on benthic organisms. The two primary biocides in use are based on copper containing, or tri (n-butyl) tin (TBT) containing, compounds with the tin based types being more effective and replacing the copper types (Hall & Pinkney, 1985). TBT oxide (TBTO) has been shown to be ten times more toxic to marine copepods than copper (Uren, 1983) and in general the TBT coatings are far more of a problem than the copper based ones. Concern overseas with the effect of TBT compounds, particularly on oyster farms, has slowly led to bans on their use on small boats in France, Sweden, the UK and parts of the US, however with Australia's fragmented environmental response pattern they are still the most common anti-fouling coatings in use in Australia. While there are no data available to estimate their toxicity to coral or effects on a coral reef the figures for their toxicity to molluscs, fish, zooplankton, crustaceans, bacteria and fungi suggest similar effects would occur with coral. Effects occur at extremely low levels (down to a few ng/l) making analytical monitoring extremely difficult and the long term environmental effects of chronic low level contamination difficult to predict (Laughlin & Linden, 1985).

3.7 Other Contaminants

A number of other contaminants which have a deleterious effect on corals but are only likely to be present in small amounts from the development include detergents and other surfactants from moored boats and the sewage effluent, trace metals from bilge water and discarded metallic debris in the marina.

4. MONITORING PARAMETERS

The monitoring parameters chosen for the baseline study reflect the concerns highlighted in Section 3 and are directly related to possible contaminants from the construction and operation of the development.

As the sediment/turbidity study was run independently, in terms of sampling, from the general water quality study it is reported separately throughout the rest of this report.