

Information Sheet on Ramsar Wetlands

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P O Box 155, North Quay
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5. Name of wetlands: Moreton Bay
6. Date of Ramsar designation: 22/10/1993
7. Geographical coordinates: 27°20'S; 153°10'E
8. General location: Immediately East and extending North-East and South-East of the City of Brisbane, the Capital of the State of Queensland.
9. Area: 113,314ha
10. Wetland type: A,B,C,D,E,F,G,H,I,L,M,O,Q,S,T,X
The main habitat types equate to: Muddy intertidal G, H, I; Sandy E; and Coral C.
11. Altitude: Varying from sea level to 280 metres at Mt Tempest, Moreton Island

12. Overview:

Moreton Bay is a semi-enclosed basin bounded on its eastern side by two of the largest sand islands in the world. It is one of only three extensive intertidal areas of seagrass, mangroves and saltmarsh on the eastern coast of Australia that provide habitat for waterbirds. Based on recent estimates (Thompson, 1990b) the bay could be upgraded from the 20th to equal 11th most important site in Australia for waders (Lane 1987).

13. Physical features:

(a) Geology and Geomorphology: Moreton Bay is one of the largest estuarine bays in Australia which are enclosed by barrier island of vegetative sand dunes. Moreton Bay is about 80km long, 35km wide in the north, tapering to less than 5km in the south. Only near Moreton Island does water depth exceed 40m. Moreton Bay is situated close to the southernmost limit of reef-building corals. These occur around Peel, St. Helena, and Green Islands, and from Wellington Point to Raby Bay (Hekel et al. 1978).

The mountains lying west of the coastal plains from south of Sydney to Fraser Island are formed chiefly by Mesozoic and Permian sedimentary rocks and granites. The eastern side of the range is and has been characterised by heavy rainfall and rapidly flowing rivers and creeks. A very large amount of detrital material is moved by these rivers to the sea, where strong longshore currents move the sediments, mainly quartz sand, northward. This process has continued all through the Quaternary to the present day (Benussi, 1975). Along the mainland shore, the Bay is bordered by extensive estuarine flats formed by coastal progradation during high sea levels of the Quaternary period of geologic time (approximately the last two million years) (Hekel et al. 1978).

The coastline of Fraser Island is characterised by sandy beaches alternating with rocky headlands. Because of these features, the movement of sand is not uniform but intermittent. The sand accumulates south of rocky headlands or river mouths, building up the beach and moving the shoreline eastward. Especially during seasonal summer storms, sand moves around obstacles towards the north (Benussi, 1975).

(b) Origins: Recent sediments are composed of two types: A. Oceanic quartz sand giving rise to immense tidal deltas consisting of sand banks; B. River sands and muds confined to the western side

of the Bay.

Unconsolidated Cainozoic sediments dominate, however rocks are exposed at Point Lookout, at Dunwich and at the south-west of North Stradbroke Island near Canaipa Passage.

The stratigraphic and geomorphic succession of North Stradbroke Island (Laycock, 1975) is as follows: Mangrove muds (organic silt), freshwater swamps - process of formation; Beach, beach ridges, and sand dunes, without vegetative cover - in process of formation). Cainozoic: Beach ridges, stabilised by vegetative cover - post-Recent emergence; Sand dunes, stabilised by vegetative cover - post-Recent emergence; Freshwater swamps in coastal regions - post-Recent emergence; Sand dunes, stabilised by vegetative cover - pre-Recent emergence. Mesozoic: Sandstone and conglomerate; Thyolite and rhyolitic tuff. Palaeozoic: Greenstone.

Fringing coral reef have formed around islands in the centre of the Bay. Notable coral reef areas include Peel Island, Goat Island, One Mile, the Rainbow Channel and a small reef off the south-west tip of Moreton Island.

Coastal headlands and most of the Bay islands of Moreton Bay are formed of Tertiary age basalts and freshwater shales, Mesozoic age sandstones, and Palaeozoic age metamorphic rocks with laterite soils developed at the surface.

In the Quaternary, the major influence on sedimentation was sizeable fluctuations (up to 150m) in sea level. This resulted from changing volumes of the oceans when water was transferred between the ocean, and glaciers and ice sheets. Moreton Bay was filled and drained several times in response in these distant glacial cycles.

During low sea level phases the bed of the Bay was exposed. Sediments dried out, weathered, and soils developed. Rivers flowed across the emerged Bay to the ocean shore which, at times of extreme low sea level, coincided with the edge of the continental shelf. As the rivers crossed the Bay they incised river valleys and transported sediment to the ocean.

At times of rising sea level, the coastline moved westwards, the former river valleys were back filled with river gravels and subsequently estuarine mud and then with marine sand and mud.

Moreton and Stradbroke Islands are drowned sand dune island barriers anchored by rocky headlands. They formed by wave and wind action during several cycles of sea level change. The stages of dune development are marked by characteristic soil profiles (Hekel et al. 1978).

Four sedimentation zone are present in the Bay under present conditions:

- Nearshore zone of active sediment accumulation: This is the tidal flat environment where sand and muddy sand is deposited and coral reef develops.
- Quiescent basin sedimentation: Depressions in the drowned former land surface have been filled by marine mud. The Brisbane, Pine and Caboolture Rivers have been the main suppliers of sediment, which rarely exceeds 10m in thickness in this zone.
- Zone of minimal deposition: Little sediment is supplied to this zone because of its distance from the source of sediment. In addition, any mud that does reach this zone tends to be kept in suspension by tidal currents thus preventing significant deposition. The older sediments remain exposed at the sea floor or are covered by only a thin layer of muddy sand.
- Tidal delta depositional zone: Much of the longshore drifting sand of the ocean beaches of Moreton and Stradbroke Islands is trapped in tidal deltas which have formed at the Southern, South Passage and Northern entrances to Moreton Bay.

(c) Climate: Being situated on a biogeographical boundary separating the tropical from the more temperate areas the climate of the bay is sub-tropical. Annual average rainfall is 113.5cm. This occurs predominately in summer during the months of October to April. Average annual temperatures for Brisbane are a maximum of 30°C and a minimum of 18°C. The site is subject to the effects of tropical cyclones which originate in the Coral Sea and may travel as far south as Moreton Bay before usually weakening into a low or rain depression as they cross the coast. Most of the rainfall from these lows usually falls in the catchment areas of the major rivers flowing into Moreton Bay and considerable silt, mud and sand is washed down into the bay when these rivers flood. From 1840 to 1893 there were eight major floods in the Brisbane River. The latest occurred in 1974 (Saunders 1975).

(d) Hydrology: On the large sand islands of Moreton and North Stradbroke rainfall filters through the sand dunes to emerge in lakes and swamps and thence into Moreton Bay and the Pacific Ocean. On North Stradbroke Islands some of this freshwater is extracted by the Local Authority for domestic use. Increased urbanisation of the central bay islands and the adjacent mainland may result in increased demands for water extraction from North Stradbroke Island. Increases in waste discharges and runoff into the bay may also occur. The bay receives most of the sewage and industrial effluent of the wider Caloundra-Brisbane-Gold Coast metropolitan areas as well as the storm water runoff containing sediment, fertilisers, pesticides and other pollutants from the urban and rural areas. These areas comprise the catchments of several large rivers and smaller creeks rising in the Lamington Plateau in

the south, north along the Great Dividing Range to the D'Aguilar Range. These rivers are: Nerang; Pimpama; Coomera; Albert; Logan; Brisbane; Bremer; Pine; and Caboolture Rivers (Laycock, 1975). The hydrodynamic nature of Moreton Bay is determined by interaction of the semi-diurnal tide, propagating mainly through the northern entrance, with the depth variations inside the bay. The tidal range inside the bay is about 20% greater than outside the bay. The patterns of the tide-height contours and the tidal currents in the bay are strongly influenced by the depth-topography of the bay. The tidal currents vary from 0.2ms^{-1} in the shallow western region to 1.0ms^{-1} in the deep channels to the north-east.

The salinity of Moreton Bay is higher on the eastern side because freshwater flows into the western side. Therefore the spatial and temporal distribution of salinity in the bay depends on the varying rainfall in the catchment of the rivers flowing into it. Higher temperatures in summer and lower temperatures in winter are recorded in the shallow western bay compared with the north-eastern are of the bay and near South Passage due to the moderating influence of the Pacific Ocean on the latter areas.

Surges due to cyclones off the Queensland coast occur in Moreton Bay while several severe local storms can cause transient changes in the water level of the bay (Harding, 1979).

(c) Water quality: Depending on water depths and circulation patterns, the Bay has a limited capacity to assimilate the large quantity of waste it receives. A draft environmental policy on water seeks to grade all Queensland waters into one of four water quality classes, Q1 to Q4. The intention is for all the waters of Moreton Bay, except near waste discharges, to ultimately meet at least Q2 standard, defined as the maintenance of a high water quality with the only discharges to be permitted being those which, at the worst, result in minor changes to the biological community.

Water depth fluctuations and permanence: Moreton Bay has experienced several sea level oscillations over the past 500,000 years and tides are semi-diurnal with an amplitude of more than 2 metres.

14. Ecological features:

The Moreton Bay region is an important habitat for many species of birds and is one of only four recognised sites of significance to wintering migratory wading birds along the eastern Australian coast (Thompson and Kikkawa 1988). Australia is a signatory to the Japan-Australia (JAMBA) and China-Australia (CAMBA) migratory bird agreements which require the habitats used by certain species listed in the agreements to be set aside as reserves. At least 34 listed species have been recorded from Moreton Bay including the eastern curlew; whipbird; bar-tailed godwit; grey-tailed tattler; ruddy turnstone; red-necked stint; sanderling; curlew; sandpiper and common sandpiper (Thompson and Kikkawa 1988). At least 254 species of bird have been recorded from North Stradbroke Island including gould's petrel, the arctic tern and the long-tailed jaeger (Vernon and Martin 1975).

Image analysis of all intertidal areas in Moreton Bay, including Pumicestone Passage estimated that a total of 23,000 ha of tidal flats are exposed at low water datum characterised by marked differences in substrate type and species of waders present (Thompson 1990b). Four types of roosts and four habitats have been determined for waders in Moreton Bay (Thompson 1991, Appendix 1) using particle size analysis. The main habitats were: muddy intertidal, often with seagrass; muddy intertidal with no seagrass, usually associated with sewage outlets; sandy; coral.

High amounts of silt were found at very muddy sites associated with slow currents. High amounts of fine sand occurred at very sandy sites with fast currents. The amount of fine sand and very fine sand in the substrate reflected estuarine conditions at a site. High percentages of fine sand were recorded at oceanic influenced sites where fast currents and limited riverine sediment deposition led to large average particle sizes. Sites with very fine sand are associated with muddy riverine conditions due to slower currents and the contribution of fine particles from nearby rivers. A relationship was shown to exist between the location of those habitat sites with high species numbers and the location of roosts. Species of waders present differed significantly among the four habitats.

The ruddy turnstone was found to be a key indicator species of the coral habitat strewn with coral rubble giving the surface considerable topographic relief. The bar-tailed godwit characterised the other extreme distinguished by sandy sites with a lush covering of seagrass (Thompson, 1990 a, 1991) (Appendix 1).

A total of 19 plant formations occur on the tidal wetlands. Six of those formations are dominated by the mangrove *Avicennia marina*. Climatic conditions in Moreton Bay provide optimum temperatures of $18-24^{\circ}$ for the growth of *Avicennia marina* for six to seven months of the year. Behind the fringing mangroves, salt-marsh is usually zoned parallel to the shoreline and consists of three plant communities broadly classified as: shrublands, the dominant species being *Sarcocornia* spp. and *Suaeda australis*; sedge (*Juncus kraussii*) and rush swamps; grasslands (*Sporobolus virginicus*) as well as bare salt pans.

Seven species of mangroves are found in Moreton Bay and major areas of mangroves are located throughout the Bay and in particular along the Pimpama River, Coomera River, North Arm and the wetlands and waterways of McCoys Creek and Woogoompah Creek. Mangroves are the nursery areas and ultimate source for food for many commercial and recreational fish species and are necessary for the prevention of erosion, the provision of habitat, landscape value and to provide roosting areas for wildlife (Arthington and Hegerl, 1988). Four main types of shorebird roosts are identifiable in Moreton Bay (Thompson, 1991):

- open sandy island or beach: found mainly on Moreton and North Stradbroke Islands with only two similar roosts known on, or adjacent to, the western side of Moreton Bay. These types of roosts are used by most species;
- salt and clay pan: scattered within and behind the mangrove fringe. Birds may find cover under mangrove trees or shelter within clumps of samphire and sedge. These roosts are also used by most species;
- inland freshwater marshes: restricted to the western side of the bay and used by species such as the Sharp-tailed sandpiper, greenshank and the black-winged stilt at all stages of the tidal cycle;
- mangroves: this is the preferred roosting situation of the grey-tailed tattler which roost standing on the branches of the mangrove trees. The whimbrell, curlew, sandpiper, terek sandpiper and the greenshank may also roost in this situation.

Saltmarsh and saltpan areas are integral with and generally adjacent to mangrove areas. Apart from providing valuable feeding and crucial roosting areas for waders (Thompson and Kikkawa 1989), these areas also represent buffers for the mangroves and function as a source of material for detrital food chains.

North and South Stradbroke Islands are barrier islands feeding sand sediments from ancient dune deposits into the eastern part of Moreton Bay (Maxwell 1970). The two islands are separated by an opening nearly 2 kilometres wide at Jumpinpin; this bar and the Southport Bar at the southern end of South Stradbroke Island are fairly unstable and do not allow a seagrass population to establish. At the northern end of North Stradbroke Island a different situation occurs. Here the orientation of this island and Moreton Island allow for large sheltered sand banks flushed twice daily by oceanic water.

From Amity Point to the northern end of Canaipa Passage shallow sand and muddy sand flats with protection from prevailing winds and strong currents make a good habitat for seagrasses. At South Passage sand has formed a fan-shaped bank known as Amity Banks. Further south the sand becomes muddier with clay and silt from the mainland and low offshore islands.

Between Canaipa Passage and the Southport Bay at the southern end of South Stradbroke Island a series of low, small islands from the deltaic complexes of the Logan, Albert, Coomera and Pimpama Rivers. Between these islands are shallow mudflats and deeper channels. These areas, protected on one side by Stradbroke Island and on the other by the mainland or offshore islands, offer excellent habitats for seagrasses (Kirkman 1975).

Intertidal and shallow waters support seven species of seagrass which occur over an area of 6522 ha. This provides food and habitat for turtles, dugong, commercially and recreationally important fish and invertebrate populations in the bay.

Research indicates that seagrass meadows are particularly vulnerable to disturbance by humans and are very slow to recover (Poiner, 1989).

South Passage and the Rous Channel plus the sand banks of the bay, particularly the Moreton and Amity Banks area, represent an internationally significant habitat for dugong. Population estimates of at least 600 have been made for this species, a high number considering the proximity of their habitat to a major city such as Brisbane (Preen et al. 1989). Dugong feed mainly on seagrass and their survival is closely linked to the protection of these seagrass communities.

Three species of turtle inhabit Moreton Bay year round. Hawksbill turtles occur only occasionally while loggerhead turtles occur in their thousands and feed on molluscs, crabs and sponges (Bustard 1972). Moreton Bay is also a significant site for feeding green turtles (Limpus C in press).

Seagrass is a significant feature and likely to have influenced feeding behaviour and distribution of shore birds. Seagrass coverage is highest in those sites around Moreton Island and North Stradbroke Island where clean oceanic waters promote high rates of photosynthesis. Seagrass coverage is reduced in the muddy waters along the mainland of Moreton Bay and in sites with coral substrate.

The sewage affected sites in Bramble Bay are entirely devoid of seagrass, as are a few sites in Pumicestone Passage and Southern Moreton (Thompson 1991).

Driscoll (1991), found that the substrate and conditions in Pumicestone Passage were not uniform throughout and that different locations had variations in the numbers of wader species present.

Most species showed a preference for particular locations but great knots and curlew sandpipers were

not as consistent and habitat links for these species were hard to define.

The differences related to: the pattern of substrate deposition; the extent of feeding areas and; the peculiarities of the tidal range in the Passage.

One third of all waders counted were bar-tailed godwits but data from Thompson (1990c) suggests that the numbers of this species present in the Passage decrease in autumn.

Conversely the number of grey-tailed tattlers was found to be higher in autumn and this was reflected in data from the Great Sandy Strait further north (Driscoll 1990).

It is possible that the numbers of grey-tailed tattlers present in south-east Queensland increase during their northward migration.

15. Land tenure/ownership of:

(a) site: Moreton Bay lies within Queensland waters. Most of the land fronting the bay consists of Crown land (under the control of the Government of the State of Queensland), with mostly privately owned land along the western shore. A number of canal estates have access to the bay and some of the privately held land is also proposed for canal estates.

(b) surrounding area: This incorporates Moreton Island National Park and on the mainland a greater proportion of privately owned land and commercial forests.

16. Conservation measures taken:

National Parks in the Moreton Bay region and managed by the Queensland National Parks and Wildlife Service of the Department of Environment and Heritage are:

Blue Lake NP 1951 on North Stradbroke Island - declared 6 February 1962 and 11 April 1981 (area 501ha)

Moreton Island NP 2155 - declared 13 August 1966 (area 15,400ha)

Pumicestone NP 1462 (Bribie Island) - declared 20 August 1988 (area 1930ha)

St Helena Island NP 3004 - declared 6 October 1979 (area 75.1ha)

Environmental Parks administered by the Queensland National Parks and Wildlife Service, Department of Environment and Heritage but which may have the local Authority as trustee are:

Beachmere EP 1238 on the western mainland side of the Bay - declared 27 February 1982 (area 16.3 ha) trustee - Caboolture Shire Council

Bird Island EP 2580 - declared 26 April 1975 (area 0.215ha) trustee - Redland Shire Council

Bribie Island EP 2699 - declared 4 November 1989 (area 1330ha) joint trustees - Caloundra City Council / Caboolture Shire Council

Buckleys Hole EP 2842 - declared 30 November 1991 (area 87.7ha) trustee - Caboolture Shire Council

Cobby Cobby Island EP 1977 - declared 11 April 1987 (area 28.3ha) trustee - Albert Shire Council

Coomera Island EP 2885 - declared 6 July 1991 (area 267.9015ha) trustee - Director Q.NPW

Goat Island EP 2579 - declared 26 April 1975 (area 2.2ha) trustee - Redland Shire Council

Kangaroo Island EP 2886 - declared 6 July 1991 (area 415.2074ha) trustee - Director, Q.NPW

King Island EP 2578 - declared 26 April 1975 (area .99ha) trustee - Redland Shire Council

Myora EP 2554 (North Stradbroke Island) - declared 1975 (area 9.7ha) trustee - Redland Shire Council

Woogoompha Island EP 2884 - declared 6 July 1991 (area 632.0177ha) trustee - Director, Q.NPW

In addition all islands which are part of the State of Queensland are Fauna Sanctuaries. Under this classification, which is not a tenure, the taking of birds and other animals is not permitted. Migratory birds are protected under this State legislation as well as through international treaties between Australia and Japan (JAMBA) and Australia and China (CAMBA).

Fish Habitat Reserves administered by the Department of Primary Industries, cover approximately 15.3% of the Bay. Clearing of mangroves within these reserves may only be carried out under permit.

Management plans for the National Parks referred to above as well as National Parks in the catchment area are being prepared and are expected to be completed by 1992.

17. Conservation measures proposed but not yet implemented:

Because of the complex pattern of shorebird distribution in Moreton Bay some species that are common on the western shores of Moreton Bay, such as the terek sandpiper, lesser golden plover, sharp-tailed sandpiper, black-tailed godwit and the marsh sandpiper, are seldom seen in the eastern sector of the bay. Therefore conservation measures need to deal with both sides of the bay to ensure sufficient habitat for all waders (Thompson, 1991) (Appendix 1).

Declaration of Moreton Bay as a Marine Park is proposed and a Strategic Plan has been prepared with the goal "to provide for economically sustainable use of Moreton Bay and for protection of its natural,

recreation, cultural heritage and amenity values" and public comments have been sought (Appendix 4).

Further areas of North Stradbroke Island are proposed as National Park and most of South Stradbroke Island is proposed as Environmental Park. Treatment of domestic effluent discharge is being upgraded to secondary level with tertiary level contemplated for the future.

18. Current land use: principal human activities:

Fishing and collecting: The Moreton Bay region supports one of the most productive fisheries in Queensland with 1,200 commercial fishermen, 400 commercial fishing vessels and providing over 4,000 jobs in catching, processing, wholesaling and retailing seafood and the supply of goods and services to the industry. It represents just under three percent of the Queensland coastline and each year produces about 20 percent of Queensland's commercial seafood catch by weight (Williams, 1991). The Bay is also a popular recreational fishing area. The waters are highly productive and yield a variety of species. Important fish species for commercial and recreational fishing include yellowfin bream, whiting, tailor, flathead, black bream, mackerel and snapper, while mullet is also important for commercial fishing. Eight species of prawn and four species of crab are commercially important, with two of the crab species, mud and blue swimmer crabs, being of recreational importance.

Bait collection, food gathering and viewing of coral and aquarium fish species are popular recreational pursuits. There is also a market for the commercial collection of fish, invertebrates, anemones and live corals for aquarium purposes from within the Bay and the offshore reefs. Commercial oyster banks operated by licensed oyster growers are common in Moreton Bay. The area between Wynnum and Fisherman Islands and around Toorbul Flats are popular for commercial worm digging. Pippies are an important source of bait and food from Moreton and North Stradbroke Islands.

During 1986, expenditure on commercial and recreational fishing activities was estimated at more than \$100 million. Further, the value of the commercial fishing haul has been estimated at \$100 million in retail value (McDonald and others 1989). These figures indicate the importance of both activities to the regional economy.

Recreation and tourism: The bay is a major area for recreational boating and water related activities with 31,000 motor boats, 1,821 sailing boats and countless dinghies using the area. It offers opportunities for a wide range of water-based recreation including fishing, sailing power boating, water skiing, parasailing, jetskiing, sailboarding, scuba diving, bird watching, marine study and snorkelling. Moreton Bay has the features necessary for such activities including sheltered waters, diversity of experiences and settings and support facilities such as boat ramps, carparking, marinas and marine services, and is easily accessible to major population centres. The southern area of the bay receives the heaviest boating use for most activities because of its sheltered waters and proximity to many boat launching facilities.

Fishing is the most popular recreational activity in Moreton Bay. A great variety of boats, gear, and fishing sites are used to catch a wide range of fish. The greatest use is in the shallow, protected and easily accessible southern and western parts of the bay.

The bay is used extensively for pleasure and competitive sailing and sailboarding. Water skiing within the Bay mostly occurs near Point Halloran, on Redland Bay, the Coomera River and the Broadwater. Parasailing occurs at two main sites in the Broadwater, one north and one south of the Gold Coast Seaway.

Several dive locations in Moreton Bay are dived regularly and offer a range of diving experiences. These include Flinders Reef, Curtin artificial reef off Cowan Cowan, the Bulwer reef drop-off, wreck diving off Tangalooma, smaller reefs off the south-west tip of Moreton Island, Peel Island, Perulpa Bay at Macleay Island and two sites near the Gold Coast Seaway. Moreton bay offers the closest open water dive spots to Brisbane suitable for learner divers.

North Stradbroke Island incorporates undisturbed natural scenery, forest and wetlands with townships providing urban services and a comfortable and convenient location for nature appreciation. South Stradbroke Island is also a valuable recreation and conservation area, close and accessible to a large and expanding mainland population. These three islands have unspoilt beaches, topographic diversity within the dunal system and developing and well established associations of native vegetation. These features are important to a region which is being increasingly urbanised.

Port facilities: Operation of the Port of Brisbane has a major influence on Moreton Bay. It is the fastest growing capital city port on the east coast (POBA 1990), geographically convenient to northern hemisphere ports subject to an on-going development program which is expanding its capabilities to handle a wide variety of cargoes. Recent changes in administration and operation by the Port of Brisbane Authority have increased and continue to increase the port's capabilities and efficiency. The Moreton Bay Strategic Plan seeks to integrate the operation and development of shipping channels

and other areas of port expansion with the natural environment.

Coral extraction: Extraction of sub-fossil coral to provide raw material for cement is a significant industry in the Bay in terms of scale, nature and economic value. Leases apply off Mud, St Helena, Green and King Islands and off parts of the western shoreline. Some live corals also exist in the lease areas.

Sand mining and extraction: Silica and heavy mineral sands are extracted primarily from North Stradbroke Island. Rutile and zircon exist in offshore deposits for which exploration leases are being considered.

In addition to North Stradbroke Island, deposits used include the northern bay banks, Middle Banks and Rous Channel. These sources are highly valued in a regional sense due to the diminishing resources available from mainland streams and terrestrial areas.

Sand mining and extraction are important revenue sources providing materials for the regional market at low transport costs.

Water extraction: Redland Shire Council's mainland water supply is supplemented by water extracted from an unconfined aquifer on North Stradbroke Island.

Education and research: The bay is an important environmental and historical education resource for primary, secondary and tertiary education. This importance is enhanced by the proximity to a large metropolitan area and its educational establishments, and the bay's range of undisturbed ecosystems.

The University of Queensland has a field station at Dunwich and Griffith University uses the bay for environmental research. CSIRO has research facilities at Cleveland, and the Department of Primary Industries has research facilities at Deception Bay and Bribie Island. The Department of Environment and Heritage has research facilities on South Stradbroke Island and educational facilities on St Helena and Moreton Islands. The recently constructed mangrove boardwalk at Wynnum North is also a significant educational resource.

The Department of Education runs environmental field study centres at Nudgee Beach, Darling Point and Jacobs Well for educating children on coastal and environmental matters.

Transport: Several of the bay's marinas and harbours provide bases for the transport operations which service surrounding locations and the bay islands. Water transport routes and associated shore-based facilities are of paramount value not only to residents but to the region's recreation, education, tourism and commercial base.

19. Disturbances/threats, including changes in land use and major development projects:

Land reclamation and soil dumping or urban and industrial development and shipping and port activities are occurring at various sites in the Bay. Up to 1m tonnes of coral and 150,000m³ of sand per annum are extracted from the Bay for use in the building, foundry and manufacturing purposes. Most pressure from human activities is being exerted on the western shoreline, which also attracts large numbers of wader species that favour muddy habitats. A series of localised problems such as the occasional "red tides" at Bramble Bay (Moss et al. 1989) have occurred due to a combination of concentrations of phosphorus and nitrogen higher than background levels combined with large quantities of treated industrial and domestic waste waters and contaminated storm water runoff. Such affects are to be reduced by minimising waste inputs from direct discharges and treating contaminated runoff.

20. Hydrological and physical values:

The two principal rivers entering the bay are the Brisbane and Logan Rivers which have an average annual discharge of 1,215,000 MI and 810,000 MI respectively. These are joined by tributaries from the southern eastern and western slopes of the D'Aguilar Range. The Logan and Albert Rivers extend from the northern slopes of the McPherson Range across the lowlands in the southern part of the region. The rivers are tidal for most of their course across the lowlands.

Moreton Bay consists of a deeper eastern section subject to strong north-south tidal circulation and a shallower western section with much weaker east-west mixing. Consequently, fine particles settle in the less turbulent western areas of the Bay while the eastern Bay is characterised by sandy sediments associated with higher tidal velocities. This maintains an ecological gradient based on particle size ensuring high levels of biodiversity.

21. Social and cultural values:

Some of the best remaining evidence of Aboriginal adaptation to a marine-based resource is to be found on Moreton Island. Other sites of significant Aboriginal cultural heritage are located on Bribie, North Stradbroke, Peel, St Helena, Macleay, Lamb, Karragarra and Russell Islands as well as Toorbul Point, Caboolture River and Victoria Point. Types of sites include middens, fish traps, artefact scatters,

quarries and scarred trees.

The shoreline of Moreton Bay was the first area in the Brisbane region to be settled by Europeans. Coochie Mudlo Island was the site of the first landing by Matthew Flinders during his exploration of Moreton Bay and the Brisbane River. St Helena Island which was used as a prison and quarantine station at different periods was the first historical area in Queensland to be reserved as a National Park solely because of its historic ruins. Other areas settled by Europeans include Peel Island, used first as a quarantine station and then as a leper colony, Dunwich and Amity Point on North Stradbroke Island and Redcliffe on the mainland which was the site initially chosen for the penal colony before it was moved up the Brisbane River to the site now occupied by the business centre of Brisbane.

22. Noteworthy fauna:

With the combination of muddy habitats (western side), sandy habitats (eastern side), coral and seagrass habitats, Moreton Bay is extremely important as a site for shorebird species (Thompson 1991). At least 43 species of wading birds use intertidal habitats in the bay, including 30 migratory species listed by JAMBA and CAMBA. More than 50,000 wintering and staging waders depend on Moreton Bay during the non-breeding season (Thompson 1990b). The bay is particularly significant for the Eastern curlews *Numenius madagascariensis* (3,000 to 5,000 birds) and the Grey-tailed tattler *Tringa brevipes* (>10,000 birds) in winter.

This diversity of habitats and species utilising the area indicates the importance of both sides of the bay when considering conservation measures. Moreton Bay also has particularly large populations of cormorants and terns, white herons, spoonbills, ibises and egrets. The bay is ranked among the top ten dugong habitats in Australia and together with the Gulf of Carpentaria and Torres Strait is considered one of the most important areas for dugong in Queensland. Herds of dugong of up to 104 individuals have been observed.

Three species of sea turtles inhabit Moreton Bay in significant numbers. Of these species, the hawksbill and green turtles are considered to be endangered and the loggerhead is regarded as threatened in a world context. However, within Australia the loggerhead is listed as an endangered species while the green and hawksbill turtles are listed as vulnerable.

Feeding green turtles are found in Princess Charlotte Bay, Moreton Bay, Shoalwater Bay, Hervey Bay and Repulse Bay. Of these locations, Moreton Bay has the largest consideration of feeding green turtles in Australia. Tagging studies have shown that the green turtles resident in Moreton Bay migrate to the southern GREAT barrier Reef (Lady Musgrave, Heron, Wreck and North West Islands) and the northern Great Barrier Reef (Raine Island) to breed.

Major concentrations of loggerhead turtles are found in Moreton and Hervey Bays and the southern part of the Great Barrier Reef. Significant numbers of young and mature loggerhead turtles inhabit Moreton Bay. This is the most significant concentration of loggerheads in Australia (C. Limpus in press).

A total of 175 species of fish are listed for Flinders Reef off Cape Moreton and at least 100 species occur inside the bay. In excess of 80 species of echinoderms have been recorded from Moreton Bay and adjacent reefs. One study identified 355 invertebrate species from 400 subtidal sites within the Bay.

Chestnut teal and Pied oystercatchers breed on the shores of the bay and Fruit bats roost in mangroves during the day. A small number of Humpback whales enter the bay, probably accidentally, each year on their way north to their breeding grounds at Hervey Bay, north of Fraser Island. Nine species of birds are dependant on mangrove vegetation. Many first year birds of migratory species remain in the bay during the breeding season when the number of migratory species present in the bay increases as they move northwards with the onset of winter. Large populations of resident birds depend on the fringing wetlands and large populations of marine birds feed in the open waters of the bay.

23. Noteworthy flora:

Species dependent on mangrove estuarine areas comprise up to 67% of the entire commercial catch of fisheries in eastern Australia. Mangroves form a fringe around much of the shoreline of Moreton Bay. Seven species have been identified but only three are considered abundant - *Avicennia marina*, *Aegiceras corniculata*, *Ceriops tagal*. Other species of mangrove include *Rhizophora stylosa*, *Excoecaria agallocha* and *Bruguiera gymnorhiza*.

Fifty-five species of algae are associated with mangroves in the bay and 2,000 ha of salt marsh vegetation have been identified.

Saltmarsh includes samphires, sedges, salt couch, bare saltflats and stunted mangroves. Important saltmarsh species include *Suaeda australia*, *Salicornia quinqueflora*. Threatened communities

consisting of Wallum woodland (*Melaleuca quinquenervia*) grow in saturated areas close to the shores of Moreton Bay.

The high diversity of marine plants include seven species of seagrass belonging to five different communities. Species are: *Zostera capricorni*, *Halodule uninervis*, *Syringodium isoetifolium*, *Halophila ovalis*, *Halophila spinulosa*, *Cymodocea serrulata*, *Halophila diciptens*. Seagrasses have been shown to be important in the life history stages of commercially important fishes and crustaceans (Hyland 1988, 1989): dugongs, turtles, swans, waders, fishes feed in or on seagrasses; seagrass allows long-billed waders (eg. bar-tailed godwit) to penetrate deeply into the substrate; seagrasses provide important settlement areas for the post-larval stage of penaeid prawns.

24. Current scientific research and facilities:

Queensland University, CSIRO and Department of Primary Industries have research stations in the Moreton Bay region. Other universities and colleges use Moreton Bay for research and education. A PhD project on migrant waders has recently been completed (Appendix 1) and further projects are planned for certain species (eg. eastern curlew). The Department of Environment and Heritage is researching the population dynamics of loggerhead turtles within Moreton Bay.

25. Current conservation education:

University of Queensland's research station on North Stradbroke Island is regularly used by High School groups. Interpretation facilities are available on Moreton Island and St Helena Islands. 1.2ha on Peel Island is leased by a local High School as a field education centre.

26. Current recreation and tourism:

An estimated 300,000 recreational fishermen spend 1.5 man days in Moreton Bay. An estimated 2,000 people visit Brisbane each year specifically to watch waders in Moreton Bay (RAOU data). Other activities include yachting, water skiing, sail boarding, scuba diving, picnicking, camping and boating.

27. Management authority:

see 28 (Jurisdiction)

28. Jurisdiction:

National Parks - Department of Environment and Heritage (Queensland National Parks and Wildlife Service); Environmental Parks - Department of Environment Heritage (Queensland National Parks and Wildlife Service) and Local Authorities where they are the trustees; Coastal Protection - Department of Environment and Heritage; Monitoring environment - Department of Environment and Heritage; Fish Habitat Reserves - Department of Primary Industries; Vacant Crown Land - Department of Lands; Local Government Reserves - Local Authorities.

29. Bibliographical references:

A list of relevant references is provided in Appendix 2

30. Reasons for inclusion:

The proposed site meets at least one category of the broad classes necessary for it to be included in the list of wetlands of international importance. 1a,b, 2a,b,c, 3a,b,c.