



Australian Government

Department of the Environment and Energy

DRAFT

THREAT ABATEMENT PLAN

for the impacts of marine debris on
vertebrate marine life (2017)



1. Background

Threat abatement plans

Threat abatement plans address **key threatening processes** listed under section 183 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A key threatening process is *a process that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community*. If the Minister decides, with advice, that a feasible, effective and efficient way of addressing a listed key threatening process is the development of a threat abatement plan, the Australian Government will work with stakeholders to develop a plan under section 270A of the EPBC Act. The EPBC Act describes the process, content and consultation required when making or varying a threat abatement plan.

The Australian Government implements actions under threat abatement plans that are its direct responsibility, and will guide the implementation of actions where other groups lead the implementation of a threat abatement plan (e.g. states and territories, industry or community groups).

The Australian Government undertakes the threat abatement planning process with assistance from stakeholders including other governments, scientific experts, industry, non-government agencies, and the community. To progress actions under the *Threat abatement plan for the impacts of marine debris on vertebrate marine life*, the Australian Government will rely on engagement from all stakeholders involved in this complex problem.

Background to this threat abatement plan

Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris was listed as a key threatening process under the EPBC Act in August 2003.

'Harmful marine debris' includes land-sourced garbage, fishing gear from recreational and commercial fishing abandoned into the sea, and ship-sourced, solid non-biodegradable floating materials disposed of at-sea. Most of these items are made of synthetic plastics. Harmful marine debris is recognised as a ubiquitous, global problem.

A threat abatement plan (TAP) was prepared in 2009 to address the key threatening process, and approved in accordance with the EPBC Act. The primary focus of that plan was the impact of entanglement and ingestion of marine debris on vertebrate marine life.

A review of action under the 2009 TAP was completed in 2015. This review concluded that it was not possible to state that the key threatening process had been abated or that the objectives of the 2009 threat abatement plan had been met, despite progress, particularly in beach clean-up efforts. The review noted that understanding of the global nature of the marine debris problem, as well as the potential sub-lethal and other impacts of microplastic and associated chemical contamination, had increased over the life of that plan.

In June 2015, the Australian Senate referred the *Threat of marine plastic pollution in Australia* for inquiry and reporting. The Senate Inquiry report into this matter (*Toxic tide: the threat of marine plastic*) was tabled on 20 April 2016, highlighting the need for improved action on many issues relevant to the threat abatement plan.

This threat abatement plan updates and replaces the 2009 TAP. It has been developed by the Department of the Environment and Energy to continue guiding the implementation of existing actions, and to incorporate new actions needed to abate the listed key threatening process (especially actions concerning developing understanding about microplastic impacts and the potential role of new technologies in waste management). The actions identified are intended to be feasible, effective and efficient, as required by the EPBC Act. The plan binds the Commonwealth and its agencies in responding to the impact of marine debris on vertebrate marine life, and identifies the research, management and other actions needed to reduce the impacts of this key threatening process on affected species. The plan is subject to review at intervals of not longer than five years.

Since 2009, marine wildlife researchers have documented additional EPBC Act listed species that are being impacted by marine debris. **Appendix A** has been updated to include these species.

Many industry, government and nongovernment stakeholders are working to address marine debris and related issues (for example through beach clean-up and management of litter and illegal dumping). A stakeholder workshop held in August 2015 established priorities for future threat abatement actions, providing a basis for this revised plan.

2. Objectives and Actions

This plan provides national guidance on specific action to prevent and mitigate the impacts of harmful marine debris on vertebrate marine life, through six major objectives:

- 1. Contribute to the long-term prevention of the incidence of marine debris.**
- 2. Identify key species, ecological communities, ecosystems and locations impacted by marine debris for priority action.**
- 3. Conduct research to understand and mitigate the impacts of marine microplastic and plastic debris on marine species and ecological communities.**
- 4. Remove existing marine debris.**
- 5. Monitor the quantities, origins, types and hazardous chemical contaminants of marine debris, and assess the effectiveness of management arrangements over time for reducing marine debris.**
- 6. Increase public understanding of the causes and impacts of harmful marine debris, including microplastic and hazardous chemical contaminants in order to generate behaviour change.**

Context for these objectives, as well as specific actions designed to achieve them are outlined below.

Objective 1. Contribute to the long-term prevention of the incidence of marine debris

Prevention of marine debris is a complex problem, involving global economic, governance, and consumer behaviour factors.

Although the debris entering and accumulating in the world's oceans is comprised of many different types of anthropogenic materials, a recent systematic review of demonstrated ecological impacts (Rochman et al., 2016) found that the majority (82%) were due to plastic. The review suggests that sufficient evidence exists for decision makers to begin to mitigate problematic plastic debris now, to avoid risk of irreversible ecological harm. Browne et al. (2015) suggest that the ultimate goal of policies related to anthropogenic debris should be to replace problematic products with safer alternatives by tasking ecologists and engineers to identify and remove features of products that might cause ecological impacts.

Plastics are an obvious, problematic target for action. In addition to their well-documented potential to harm marine wildlife through entanglement and ingestion, plastics may also be chemically harmful in some contexts — either because of their potentially toxicity or because they absorb other pollutants (Rochman et al., 2013).

Globally, the loss of plastic to the environment is increasing at an exponential rate. The World Economic Forum estimates that 95 per cent of plastic packaging material value (or over \$80 trillion annually) is lost to the economy after a short first use (World Economic Forum, 2016). Jambeck et al. (2015) calculated that during 2010, 275 million metric tons of plastic waste was generated in 192 coastal countries, with 4.8 to 12.7 million tonnes entering the ocean. For microplastic particles (in this case, items above 0.33 mm), van Sebille et al. (2015) estimate that globally in 2014, 15 to 51 trillion particles, weighing between 93 and 236 thousand tonnes were present in the ocean. The Ocean Conservancy (2015) estimates that the ocean may contain upward of 150 million tonnes of plastic.

Wilcox et al. (2016) used expert elicitation to estimate the impacts of plastic pollution on marine wildlife. The survey indicated that fishing gear, balloons and plastic bags were considered the biggest entanglement threat to marine fauna, and plastic bags and utensils were rated as the biggest ingestion risk for seabirds, turtles and marine mammals.

Fragmentation of larger items, introduction of small particles that are used as abrasives in cleaning products, spillage of plastic powders and pellets in sewage waste have been identified as potential routes for entry of microplastics (including beads and fibres) into the environment. Ingestion of

microplastic provides a potential pathway for the transfer of pollutants, monomers, and plastic-additives to organisms with uncertain consequences for their health (Browne et al., 2011).

Reisser et al. (2013) characterised and estimated the concentration of marine plastics in waters around Australia and inferred their potential pathways. The marine plastics recorded were predominantly microplastics resulting from the breakdown of larger objects made of polyethylene and polypropylene (e.g. packaging and fishing items). Mean sea surface plastic concentration was over 4000 pieces per km², and after incorporating the effect of vertical wind mixing, this value increased to nearly 9000 pieces per km². These microplastics appear to be associated with a wide range of ocean currents that connect sampled sites to their international and domestic sources, including populated areas of Australia's east coast.

Australian action can contribute to reducing the effects of plastic marine debris on marine wildlife globally, particularly through development of innovative concepts and technologies that help prevent plastic debris entering the marine environment. Domestic policies concerning materials, supply chains, product stewardship, waste management and resource recovery can all assist in minimising the volumes of debris entering the ocean. Australia is also working at the regional and international level to address the issue of marine debris, particularly through the United Nations General Assembly, the Convention on the Conservation of Migratory Species of Wild Fauna, the International Whaling Commission, and the South Pacific Regional Environment Programme.

Marine debris may have either land or marine-based sources. Each scenario provides distinct issues for long term prevention.

Land-based sources

Land-based sources are a major contributor to marine debris. A study of plastic waste on coastal beaches in the greater Sydney region in New South Wales, found high correlations between plastic debris and both the frequency of storm-water drains and local population sizes (Duckett et al., 2015). This research indicates that storm-water drains are delivering plastic waste to coastal ecosystems, with the amount of plastic debris proportional to the size of the surrounding population.

Chronic exposure to plastic pollution is likely to occur at a more local scale in the vicinity of sewage, storm-water, aquaculture, and industrial discharges. Discharges from these sources occur along the Great Barrier Reef coast, with, for example, over 50 operational wastewater treatment plants discharging into rivers that are connected to the Great Barrier Reef marine environment (Kroon et al., 2015).

Pre-production resin plastic pellets (or nurdles) are produced and shipped around the world in significant volumes. These pellets can be lost to the environment in many ways, but spillage around factories and transport over land are major factors. Pellets spilt on land may eventually find their way into drainage systems and out to sea, contributing to marine microplastic debris levels. The non-government organisation Tangaroa Blue has introduced Operation Clean Sweep to Victoria (funded through the Victorian Government's Litter Hotspots Program) with the aim of ensuring that resin pellets are contained, reclaimed and/or disposed of properly, and with a goal of zero pellet loss.

'Plastic Free July' is a further example of effective community based action aimed at raising awareness of the issues associated with single-use disposable plastic. This initiative (developed by Western Metropolitan Regional Council in Perth, Western Australia and now attracting national and international interest) encourages the public to refuse single-use plastic every July, focusing on plastic bags, bottles, takeaway coffee cups and straws.

The majority of plastic enters the ocean from a small geographic area, with over half coming from five rapidly growing economies—China, Indonesia, the Philippines, Thailand, and Vietnam (Ocean Conservancy, 2015). Recent, significant economic gains, reduced poverty, and improved quality of life in these countries have generated demand for consumer products that has not yet been met with a commensurate waste-management infrastructure.

As well as improving waste, litter and stormwater management domestically, improving marine debris management in regional developing countries will improve outcomes for Australia's marine wildlife, particularly for migratory species that use areas affected by these international sources. This will require immense resources and effort, beyond the scope of this plan. However, while marine debris is the result of outflow of waste from global economic activity, much can be done by Australia domestically to provide leadership and coordination in limiting further contributions of marine debris to the ocean.

Reisser et. al. (2013) suggest that plastics along Australia's east coast are mostly associated with domestic inputs. Hardesty et. al. (2016) identified hotspots of coastal debris across Australia in order to cost-effectively identify regions for targeted waste reduction. They found relatively high loads in Western Australia due to prevailing onshore transport from wind and wave action, along with potential transport from currents in the Indian Ocean. On the east coast of the mainland, the debris loads increase from Queensland south to New South Wales, and further increase on the Victorian coastline, likely due to transport of materials southward along the coast in the East Australian Current. The researchers suggest that debris from Brisbane appears to be exported

southward, and transported onshore by wind and waves. This plume is steadily joined by additional debris from sources down the populated eastern coast, with deposition along the way, leading to the highest levels on the Victorian coastline. Tasmania, South Australia and the Northern Territory have relatively low debris loads, compared with the other states.

Marine-based sources

Australia is party to Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL), which regulates garbage pollution from ships (including fishing vessels). The discharge of plastic into the sea has been prohibited under MARPOL Annex V since 1988, as has the discharge of all types of garbage into the sea, with very limited exceptions (not related to plastics) from 2013. MARPOL also obliges parties to ensure that all ports and terminals have adequate facilities to receive ships' wastes. Adequate ships' waste reception facilities assist and encourage ships' crews to dispose of plastic wastes appropriately. The potential biosecurity risks posed by ships' waste delivered to port waste reception facilities is an important consideration.

Kroon et al. (2015) noted that for the Great Barrier Reef, chronic exposure to marine debris is likely to occur in areas frequented by ships, primarily in ports and marinas, at anchorage areas, at moorings, and to a lesser extent along shipping lanes.

Effective implementation of MARPOL Annex V varies. For example, small fishing vessels (under 100 gross tonnes) represent the majority of the world's fishing fleet and are not required under MARPOL to maintain a garbage management plan or garbage record book on board. Fisheries observer data for 2003-2015 concerning purse seine and longline vessels operating in the western and central Pacific Ocean noted more than 10,000 pollution incidents within the exclusive economic zones of 25 Pacific countries and territories, and in international waters. A majority of the purse seine pollution incidents concerned dumping of plastics waste (Richardson et al., 2016).

New technologies (such as shipboard gasification waste-to-energy systems) and accessible and affordable waste reception facilities at ports are likely to play important roles in addressing the challenges of ship waste in the future. The International Maritime Organization (IMO) is currently developing standards for shipboard gasification waste to energy systems and associated amendments to regulation 16 of MARPOL Annex VI to allow use of these systems on ships.

Community action can also lead to significantly improved outcomes in preventing marine debris from ship based sources and protecting wildlife. For example, in 2005, after the initial Cape to Cape Beach Clean Up, community members of the Tangaroa Blue Foundation at Margaret River, Western Australia analysed data on items collected during the event to identify which items were coming from local sources, and what plans could be created to prevent their loss to the

environment. This process (known as Source Reduction Planning) led to the Western Australia Government, in consultation with the commercial and recreational fishing bodies, introducing regulations to prohibit at-sea possession (in State waters) of plastic bait bands used to secure cartons of bulk bait on fishing vessels. Plastic bands pose a significant risk to a range of marine life with sea lions, seals and sharks particularly susceptible to injury or death through entanglement in uncut plastic straps.

Wilcox et al. (2015a) recognised that globally, 6.4 million tonnes of fishing gear is lost in the oceans each year (referred to as ghost gear or ghost nets). This gear is predominantly comprised of plastic material and, whether accidentally or deliberately discarded, threatens marine wildlife through indiscriminate entanglement.

Discarded, lost and abandoned fishing nets are a significant transboundary issue in the Arafura and Timor Seas region. This region sustains fisheries which support livelihoods in the littoral nations of Indonesia, Timor Leste, Papua New Guinea and Australia (Butler et al., 2013). Northern Australia has some of the highest densities of ghost nets in the world, with up to three tonnes/km washing ashore at some shorelines, annually. Gillnets and other passive fishing gears are thought to be the most problematic of ghost nets (Gilman 2016, Wilcox et al. (2015a)). Australian fisheries report that responsible fishing practices are in place and that codes of practice guide their activities concerning end of life fishing gear.

Coastal clean-ups in Australia show that recreational fishing appears to provide a source of very high impact material (Wilcox pers. comm., 2016).

In 2016, the Food and Agriculture Organization of the United Nations (FAO) produced a technical paper on *Abandoned, lost or otherwise discarded gillnets and trammel nets: methods to estimate ghost fishing mortality, and the status of regional monitoring and management*. The publication provides an important context for Australian fisheries that seek to limit their environmental impacts by providing preventive methods to avoid and minimise fishing gear becoming abandoned, lost and discarded, as well as ways to reduce the longevity of gear that is abandoned, lost or otherwise discarded. The FAO notes that ghost fishing mortality is of particular concern for marine mega-fauna, particularly long-lived, and slowly reproducing seabirds, sea turtles, marine mammals, sharks and their relatives, and some bony fishes.

Many marine species, particularly fish species, associate with objects drifting on the surface, such as logs or branches. This behaviour is highly advantageous to fishing operations, as fishing around floating objects is associated with more successful catches (Davies et al., 2014). However, the use internationally of drifting fish aggregating devices (FADs), which are often comprised of

synthetic ropes and netting is a further potential source of marine debris where the FAD is abandoned, lost or discarded.

Although there has been confusion over the legal status of FADs in relation to marine debris, under MARPOL and Annex V definitions, FADs become derelict fishing gear once they become uncontrolled. This constitutes an illegal disposal under MARPOL Annex V if the FAD includes synthetic ropes, webbing, or other plastics (National Research Council 2009). The Pew Environment Group estimated that the number of drifting FADs deployed in the world's oceans each year ranges from 47,000 – 105,000, demonstrating the scale of FADs use globally, as well as their potential contribution to marine debris if discarded, abandoned or lost. Awareness of the impacts caused by uncontrolled FADs is increasing and their use in tuna fisheries in Indonesia and Western and Central Pacific fisheries has been reduced.

Community action in the form of ghost net art has proven to be an effective means of alerting the public to the damage that discarded, lost and abandoned fishing gear causes in the marine environment. The former non-government organisation GhostNets Australia sponsored in excess of twenty ghost net art workshops in Indigenous communities between 2009 and 2013. As a result, Indigenous ghost net art now appears regularly in galleries and art fairs around Australia.

Actions for Objective 1 (Contribute to the long-term prevention of the incidence of marine debris)

Action	Priority/ timeframe	Outcome	Output	Responsibility
1.01 Establish a TAP team to coordinate TAP actions for the life of the plan.	High Priority — within 6 months of the TAP being in place, meetings re-occur on a 6 monthly schedule.	Better coordinated decision making and action on marine debris.	Agenda and action based meetings of representatives of relevant agencies and organisations (for example the Department of the Environment and Energy, State and Northern Territory agencies, the Australian Fisheries Management Authority (AFMA), Australian Maritime Safety Authority (AMSA), Australian Border Force, Australian Antarctic Division, CSIRO, non government and industry groups) mean that key stakeholders are able to contribute to the timely coordination of actions under the TAP.	Australian Government Department of the Environment and Energy
			Over time more targeted teams are established under this group to address specific issues, (for example ghost nets) with status reports supplied to the broader TAP team.	
			A continuously updated list of stakeholders with marine debris interest (detailing the marine debris resources, expertise and frameworks they bring to the issue in the Australian context).	
1.02 Limit the amount of single use plastic material lost to the environment in Australia	High priority ongoing for the life of the plan.	A decrease in the impact of single use plastic waste items on marine fauna.	Industry-led voluntary agreement to phase out microbeads in personal care, cosmetic and cleaning products by 2018	Australian Government, Australian states and territories, local governments, industry and retailers
			Government purchasers consider marine debris impacts in procurement, consistent with Commonwealth Procurement Rule: 4.5 <i>When conducting a procurement, an official must consider:</i> <i>e. environmental sustainability of the proposed goods and services (such as energy efficiency and environmental impact); and</i> <i>f. whole-of-life costs.</i>	
			Event guidelines developed for limiting waste and potential debris generated at Australian Government events	
			Town planning standards are put in place limiting the potential for marine debris inputs resulting from coastal developments	
			Sites of high litter loads are identified and infrastructure such as gross pollutant traps, litter booms and bins are installed and maintained at these sites.	
Plastic production and transport infrastructure are designed to lower risk of industrially sourced marine debris (e.g. “operation clean sweep”)				

Actions for Objective 1 (Contribute to the long-term prevention of the incidence of marine debris) - continued

Action	Priority/ timeframe	Outcome	Output	Responsibility
1.03 Encourage development of a circular economy in Australia	High priority ongoing for the life of the plan	Materials prevented from entering the environment as waste Improved recycling and reuse of valuable resources	Systems are designed and put in place to prevent waste and encourage recovery of valuable materials (for example container deposits schemes, more recyclable products).	All levels of Government, with industry involvement
		The use of available technology to reuse plastic is increased	Site-specific logistical support is put in place involving remote communities in state-based container deposit schemes (where such schemes are in place). For example, improved trucking/barge backload of recyclables for remote communities.	State, Northern Territory and Local Government, with community support
		Assurance on the environmental suitability of the degradable and compostable plastics available in Australia	Updated standards, improved information and labelling related to the development, use and appropriate disposal of degradable and compostable plastics. Research is undertaken concerning understanding the full life cycle of any newly developed plastic.	Australian Government

Actions for Objective 1 (Contribute to the long-term prevention of the incidence of marine debris) - continued

Action	Priority/ timeframe	Outcome	Output	Responsibility
	Medium priority— within 3 years of the plan entering into effect	Informed decisions on the practicalities of waste to energy technologies (at a scale and cost practical for remote Australian conditions) to enable waste material such as recovered ghost nets to be used to generate energy.	An assessment of the environmental impact and cost effectiveness of the use of waste to energy systems in remote coastal communities and at ports is conducted, informed by technologies and innovation programs being undertaken internationally and noting that standards for gasification systems are currently being prepared for the maritime sector.	Australian Government
1.04 Encourage innovation in recovery and waste treatment technologies	Medium priority ongoing for the life of the plan	Better understanding of microplastic outflows and the potential for capture of this material before it enters the environment	Innovation grants relating to improved recovery and waste treatment technologies are put in place.	States and NT, Australian Governments, with industry and community involvement

Actions for Objective 1 (Contribute to the long-term prevention of the incidence of marine debris) - continued

Action	Priority/ timeframe	Outcome	Output	Responsibility
1.05 Improve management of ghost nets	High Priority Review prepared within 2 years of the TAP being in place	<p>Improved domestic and regional management of abandoned, lost or otherwise discarded fishing gear</p> <p>Australia plays a role in building international solutions on abandoned, lost or otherwise discarded fishing gear</p>	<p>A review of Australia's engagement on abandoned, lost or otherwise discarded fishing gear in the Asia Pacific region – with a determination on the appropriateness of current actions.</p> <p>Considerations:</p> <ul style="list-style-type: none"> the cost effectiveness and environmental impacts of current and potential disposal techniques for discarded, lost and abandoned fishing gear (for example, burning in situ on beaches, transfer to land fill, recycling or potential waste to energy treatment) assessment of the potential for cost effective alternative materials for nets (ensuring that catches of target species are not reduced) an agreed management process for net incursions into the Australian Exclusive Economic Zone – for example, a permit process (at cost) for entry to retrieve damaged nets Implementation of use of ghost net toolkits developed by the former GhostNets Australia to assess the relative contributions of international and Australian commercial and recreational fishery to the total amount of lost and discarded fishing gear present in the Gulf of Carpentaria, with a view to implementing source reduction planning where possible engagement with countries in the Asia Pacific (particularly the Arafura and Timor Sea region) and the potential for incentive schemes for return of end of life fishing nets and fishing net leasing arrangements business plans for micro interest loans arrangements for fishing nets (with nets returned at end of life) in regional developing economies marking of fishing gear to enable identification of owners the extent to which current Australian fishing practices comply with FAO preventive methods to avoid and minimize fishing gear becoming abandoned, lost and discarded the potential benefits from Australian Government vessels carrying transponders for attachment to discarded, lost and abandoned fishing gear for tracking and potential retrieval <ul style="list-style-type: none"> reporting mechanisms. 	Australian Government Department of the Environment and Energy
	High priority over the life of the plan	Less impact globally on marine wildlife resulting from lost or otherwise discarded fishing gear	Engagement with best practice international forums on abandoned, lost or otherwise discarded fishing gear e.g. Committee on Fisheries (COFI), a subsidiary body of the FAO Council.	Australian Government Department of Agriculture and Water Resources, AFMA

Actions for Objective 1 (Contribute to the long-term prevention of the incidence of marine debris) - continued

Action	Priority/ timeframe	Outcome	Output	Responsibility
1.05 Improve management of ghost nets (continued)	Low priority, but progressed by 2022	Less impact globally on marine wildlife resulting from lost or otherwise discarded fishing gear	Encourage an international forum with fishing gear and materials/plastics industry experts to determine long term solutions on lost and discarded fishing gear.	Department of the Environment and Energy CSIRO
	High priority from 2017 for the life of the plan	Less impact on wildlife in domestic waters as a result of recreational fishing	Implementation of the national code of practice for recreational fishers (in preparation, expected 2017) in relation to lost and discarded recreational fishing gear and litter.	Department of Agriculture and Water Resources All states and NT governments
1.06 Improve shipping waste management	High priority, ongoing for the life of the plan	States / NT have legislation relevant to MARPOL in place	Ongoing changes to MARPOL are incorporated in state and NT legislation. Enactment of state and NT legislation to mandate provision of waste reception facilities at ports/boating hubs (where this legislation exists). Where this legislation is not in place, consider how this can be encompassed in State/NT legislation and policies. Communication of facilities/services available and waste management options available.	All State and NT governments Australian Maritime Safety Authority
		Less waste discarded from vessels	Support for work being undertaken in the region, including work by the Secretariat of the Pacific Regional Environment Programme (SPREP) on the management of ships waste through the Regional Reception Facilities Plan for the Small Island Developing States in the Pacific Region. Australian participation on the IMO's Sub-Committee on Pollution Prevention and Response to support and contribute to, as appropriate, the development and implementation of new technologies for the management of waste on board ships, for example gasification waste to energy technology.	Australian Government (particularly AMSA)
		Improved management of biosecurity waste Shipping ports generally have better waste management in place	Provision of waste reception facilities is incorporated at the planning stage for new port developments/port expansions Environmental management plans that incorporate marine debris management as part of the ports overall waste management are in place. Ports implement litter and marine debris management plans (including ghost net disposal and management in required areas). Improve the availability and adequacy of waste reception facilities at Australian ports and boating hubs, including the removal of disincentives for vessels to use waste reception facilities. This also includes reviewing the biosecurity risk of ships' waste, with a view to maximising recycling and minimising costly biosecurity control options, such as deep burial. Container deposit scheme hubs at ports to be considered.	All State/NT government planning/environment agencies Department of the Environment and Energy (EPBC Act) Ports Australia Department of Agriculture and Water Resources

Objective 2. Identify key species, ecological communities and locations impacted by marine debris for priority action.

Appendix A identifies EPBC Act-listed species for which there is a scientifically documented adverse impact resulting from marine debris. As understanding on species impact grows (through understanding of microplastic impact for example), this list is likely to increase. For example, in two whale shark (*Rhincodon typus*) stranding cases in the Philippines, necropsies revealed plastic materials in the animal's stomachs (Response series, Philippine Aquatic Wildlife., 2014). With the whale shark listed as vulnerable and migratory under the EPBC Act, confirmation of lethal or sublethal impact resulting from plastic ingestion will lead to the whale shark's addition to the **Appendix A** impacted species list.

Appendix B shows the single EPBC Act-listed ecological community (*Posidonia australis* seagrass meadows of the Manning-Hawkesbury ecoregion) for which marine debris (litter) is identified as a threat. As understanding of marine debris impact develops, further ecological communities may also be identified as impacted. For example, climate change is identified as the major threat to the listed Endangered ecological community *Giant Kelp Marine Forests of South East Australia*, but land based pollution is a recognised secondary threat, which may become increasingly relevant.

Ocean circulation patterns can concentrate marine debris at certain locations along the coast and within Australian waters. To prioritise protection of species, it is important to understand where these accumulations occur, and their overlap with threatened species distributions and other marine priorities, such as World Heritage Areas, Commonwealth Marine Reserves, Marine Key Ecological Features and Biologically Important Areas. For example, debris along the northern Australian coastline is driven by oceanic currents that circulate in a clockwise gyre, with materials transported into the Gulf of Carpentaria by southeasterly trade winds. This is cause for concern because the waters of the Gulf support important foraging, breeding, and nesting grounds for six of the world's seven marine turtle species (Wilcox et al. 2015a).

Actions for Objective 2 (*Identify key species, ecological communities and locations impacted by marine debris for priority action*).

Action	Priority/ timeframe	Outcome	Output	Responsibility
2.01 Update the list of marine debris impacted EPBC species, as scientific evidence is published.	Medium priority ongoing for the life of the plan	Better understanding of the EPBC threatened species most in need of action and protection in relation to marine debris.	An annual literature review to maintain an up to date list of EPBC Act threatened species for which the impact of marine debris is clearly demonstrated.	TAP team, Department of the Environment and Energy
2.02 Monitor ecological research on marine debris to determine if further EPBC listed ecological communities are threatened by marine debris.	Medium priority ongoing for the life of the plan	Better understanding of the EPBC Act threatened ecological communities most in need of action and protection in relation to marine debris.	An annual literature review to maintain an up to date list of EPBC Act threatened ecological communities for which the impact of marine debris is clearly demonstrated.	TAP team, Department of the Environment and Energy
2.03 Identify locations within Australian waters where major circulation patterns cause aggregations of marine debris	High priority – within 3 years of the plan entering into effect	Better understanding of the locations at which EPBC Act threatened species and ecological communities are most at risk. Correlation of these locations with other priority marine sites (e.g. Commonwealth Marine Reserves, Marine Key Ecological Features)	Maps identifying marine debris accumulation sites	NESP, Department of the Environment and Energy

Objective 3. Conduct research to understand and mitigate the impacts of marine microplastic and plastic debris on marine species and ecological communities.

Marine debris research in the 1980s found that accumulating debris posed increasingly significant threats to marine mammals, seabirds, turtles, fish, and crustaceans (Laist 1987). Threats at this time were assumed to be straightforward and primarily mechanical (through entanglement or ingestion). More recently, ingestion of microplastics has been demonstrated in a range of marine organisms (Cole 2011) and this may be leading to more complex and as yet, little understood, impacts.

For the purpose of this TAP, plastic debris and its impacts are categorised as follows:

- large debris, such as lost or discarded fishing gear, which may entangle wildlife
- small plastic pieces (>5mm) which can be ingested by biota, causing ecotoxicological effects, physical blockage and internal injuries
- microplastics particles (<5mm) that pose an ecotoxicological risk through ingestion. These particles can be transferred to higher levels in the marine food chain and may serve as a transport mechanism for accumulated contaminants such as persistent organic pollutants

As plastic debris accumulates in the environment, exposure to physical, chemical and biological processes results in its fragmentation into smaller pieces and the potential for ingestion by animals increases (Browne et al., 2008). The size range of microplastics overlaps with the preferred particle size ingested by animals at the base of the marine food web, with detritus, suspension and filter feeders readily able to ingest the fragments. This leads to uptake and trophic transfer of the plastics themselves and any chemicals they contain or have absorbed from seawater (Galloway and Lewis 2016). Improved understanding of the ways in which plastic and microplastic impact and interact with the marine environment is imperative to beginning the task of mitigating its impact.

Seabirds are particularly vulnerable to this type of pollution and are widely observed to ingest floating plastic, with Wilcox et al. (2015b) suggesting that nearly all species of seabirds will eventually be found ingesting plastic at some level, based on the discoveries reported so far.

Verlis et al. (2013) investigated the occurrence of marine debris ingestion in the wedge-tailed shearwater, *Ardenna pacifica*, on Heron Island in the southern Great Barrier Reef. Their findings indicate that 21% of surveyed chicks are fed plastic fragments by their parents, having ingested

3.2 fragments on average. The most common colours of ingested plastic fragments were off-white and green (37.5 and 31.3 percent respectively). Tanaka et al. (2013) analysed polybrominated diphenyl ethers (a very common class of flame retardants) in short-tailed shearwaters (*Ardenna tenuirostris*) collected in the North Pacific Ocean. Their data suggests that these plastic-derived chemicals are transferred from ingested plastics to the abdominal fat tissues of the seabirds.

Other observations on microplastic impacts include those of Sussarellu et al. (2016) in oysters where polystyrene microparticles were shown to interfere with energy uptake and allocation, reproduction, and offspring performance. Wardrop et al. (2016) provided experimental evidence that microbeads from personal care products are capable of transferring sorbed pollutants (specifically polybrominated diphenyl ethers) to Murray River rainbow fish *Melanotaenia fluviatilis* that ingested them. This research notes that implications for the food chain, including human diet, require further investigation.

Cannon et al. (2016) noted that plastic ingestion studies for fish are still in their infancy, especially in the southern hemisphere. They provide a standardised sampling protocol and recommend it be employed across future studies to increase consistency and allow for more accurate comparisons across species and locations.

Schuyler et al. (2016) estimated that up to 52% of sea turtles may have ingested debris. Schuyler et al. (2014) reviewed studies published between 1985 and 2012 that involved necropsies of seven or more marine turtles and found that general plastic was the number one debris found to be ingested followed by soft plastic, rope and styrofoam. Fujisaki and Lamont (2016) report a substantial increase in sea turtle nesting activities after the removal of large debris from nest beaches, indicating that large debris may have an adverse impact on sea turtle nesting behaviour.

As an example of the extent of plastic pollution and the concern this issue generates, Barnes et al. (2010) conducted the first coordinated joint marine debris survey to reveal floating macroplastics in remote seas around East and West Antarctica in 2007-8. They surmised that the seabeds immediately surrounding continental Antarctica are probably the last environments on the planet yet to be reached by plastics. However they noted that, with pieces of plastic floating into the surface of the Amundsen Sea, this seems likely to change. Australian scientists are planning to investigate the impact of micro plastics on the Southern Ocean food web in Antarctica during the life of this plan.

Actions for Objective 3 (Conduct research to understand and mitigate the impacts of marine microplastic and plastic debris on marine species and ecological communities)

Action	Priority/ timeframe	Outcome	Output	Responsibility
3.01 Build understanding related to microplastic pollution	High priority, over first 3 years of the life of the TAP	<p>Improved understanding of the links between microplastic ingestion, the resultant physical consequences for individuals and flow on impacts at multiple scales (species, populations, and community)</p> <p>Predictions on microplastic risk / threat for EPBC listed species</p>	<p>An appropriate suite of bio-indicator species (invertebrate and vertebrate) is identified for long term monitoring to measure the impact of marine microplastic plastic debris.</p> <p>Research on bioaccumulation and biomagnification of ingested microplastic contaminants in marine organisms, across biological scales</p> <p>Ranking of impact risk for microplastic types (potentially informed by the developing understanding of human health impacts of microplastic — for example through usage of plastic implants in medicine).</p> <p>An assessment of the morbidity and the differential toxicity of plastic types for bio-indicator species</p> <p>Research on the morbidity threshold (especially for impacted EPBC listed vertebrates) from ingestion of microplastic, including generational impacts such as reproductive effectiveness.</p> <p>Research is conducted on the physical pathways which lead to marine debris, including microplastic. For example, understanding of the micro plastic content in land-based sewerage outputs</p>	The National Environmental Science Programme (NESP) Marine Biodiversity Hub
3.02 Determine microplastic's relevance to the Australian Government's Science and Research Priorities and corresponding Practical Research Challenges,	Medium priority	Potentially strengthened research focus on microplastic	A determination on whether microplastic pollution should be considered under the Australian Government's Science and Research Priorities	<p>Department of Industry, Innovation and Science</p> <p>Department of the Environment and Energy</p>

Action	Priority/ timeframe	Outcome	Output	Responsibility
3.03 Survey marine plastic pollution in the southern ocean, sub-Antarctic islands, as well as other high value offshore island environments.	High priority, over first 2 years of the life of the TAP	<p>Improved understanding of the plastic pollution risk/threat to EPBC listed impacted species in the southern ocean, sub-Antarctic islands as well as other high value offshore island environments</p> <p>Potential for source reduction based on the information gathered</p>	A baseline assessment of plastic marine debris and its potential wildlife impacts the southern ocean, sub-Antarctic islands as well as other high value offshore island environments	<p>States and Territories</p> <p>Department of Environment and Energy</p> <ul style="list-style-type: none"> • Parks Australia • Australian Antarctic Division

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Objective 4 Remove existing marine debris

Through the efforts of Indigenous ranger groups in northern Australia, as well as Australian Government agencies and non-government organisations such as the Australian Marine Debris Initiative, Tangaroa Blue, the Surfrider Foundation and the South West Marine Debris Cleanup (Tasmania), Australia has an established network acting to remove marine debris from beaches. These activities prevent significant quantities of debris returning to the ocean and continuing to interact with marine biodiversity.

Approximately 65 Indigenous ranger groups in coastal areas undertake marine debris removal functions (including ghost nets) as part of their activities under the Jobs, Land and Economy programme. For example, the Dhimurru Rangers of north east Arnhem Land conduct regular beach clean-ups which remove tonnes of marine debris each year. Rangers have found between 800 to 1000 kg per km of marine debris washed ashore on much of Dhimurru Indigenous Protected Area coastline each year.

Lost and discarded fishing gear (ghost nets) is a major component of debris identified for removal. The location and scale of many ghost nets can prevent their removal from beaches where they land. The non-government organisation GhostNets Australia was involved in coordinating the removal of nets across northern Australia until 2013, and developed a ghost net identification kit. World Animal Protection's Global Ghost Gear Initiative is working with the Northern Prawn Fishery to remove ghost nets from the Gulf of Carpentaria. The Australian Fisheries Management Authority, working in partnership with the Australian Border Force and Parks Australia, has successfully recovered and disposed of abandoned foreign gillnets sighted inside the Australian Exclusive Economic Zone and Torres Strait Protected Zone.

Clean up activities provide an opportunity to record valuable data on the types of objects found, allowing identification of frequently found items and, potentially, their source. The Australian Marine Debris Initiative has built a system of Source Reduction Planning into its work and have achieved important results, including bringing about legislative change in Western Australia.

A potentially innovative approach to removing plastic involves using certain strains of microorganisms with the capacity to degrade plastics. These microorganisms use synthetic polymers as their sole source of carbon. Some types of plastics are highly biodegradable, while others, such as polystyrene, have low biodegradability. Polymer biodegradation in natural ecosystems is affected by environmental and microbiological factors and further advances in biochemistry and biotechnological fields could offer new perspectives on the bioremediation of plastic contamination (Caruso 2015).

Zettler et al. (2013) noted that plastic has a longer half-life than most natural floating marine substrates, and a hydrophobic surface that promotes microbial colonisation and biofilm formation, differing from other substrates in the upper layers of the ocean. Reisser et al. (2014) identified that anthropogenic, millimetre-sized plastic polymers have created a new pelagic habitat for microorganisms and invertebrates. This 'epiplastic' community appears to influence the fate of marine plastic pollution by affecting the degradation rate, buoyancy, and toxicity level of plastics. Diatoms were identified as the most diverse group of plastic colonisers, with bryozoans and barnacles also recorded. Rounded, elongated and spiral cells putatively identified as bacteria, cyanobacteria and fungi were also found. The researchers speculate that apart from providing long-lasting buoyant substrata that allow many organisms to disperse widely, marine plastics may also supply energy for microbiota capable of biodegrading polymers and/or associated compounds, and perhaps for invertebrates capable of grazing upon plastic inhabitants.

Actions for Objective 4 (*Remove existing marine debris*)

Action	Priority/ timeframe	Outcome	Output	Responsibility
4.01 Support beach based clean-up efforts	High priority Ongoing for the life of the TAP	Funding for ongoing beach clean-up efforts from community groups and Indigenous ranger groups in coastal regions across Australia preventing marine debris returning to the sea Evidence to aid source reduction planning (from beach clean-up data) continues to build.	Removal of marine debris from Australia's coastal environment. Collected materials reused, recycled or appropriately landfilled Data on the types of marine debris collected in beach based clean-up efforts	Australian, state, Territory and local governments. Community groups
4.02 Improve the effectiveness of Australian Government grants in relation to marine debris operations	Medium priority Ongoing for the life of the TAP	Australian Government grant recipients have increased consideration of marine debris and its impacts Additional data available on marine debris	Australian Government grant recipients required to consider litter/marine debris consequences in their projects Australian Government environment grant recipients required to collect data and report on the types and amounts of marine debris removed or observed.	Australian Government / Department of the Environment and Energy

Actions for Objective 4 (Remove existing marine debris)

Action	Priority/ timeframe	Outcome	Output	Responsibility
<p>4.03 Removal of derelict fishing gear from Australia's ocean and coast</p>	<p>High priority Ongoing for the life of the TAP</p>	<p>Mechanisms for public reporting of ghost nets are improved.</p> <p>Existing data and models contribute to safe, cost efficient removal of ghost nets in the Gulf of Carpentaria</p> <p>Continued collaboration between Australian Border Force, the Australian Fisheries Management Authority, Australian Maritime Safety Authority, and Commonwealth Marine Reserves (Parks Australia) in net identification, tagging and removal. from Commonwealth waters across Northern Australia</p>	<p>National coordination and an identified single point of contact in relation to survey, intercept and recovery of ghost nets, following advice from Action 1.05 (review of Australia's engagement)</p> <p>Identified ghost net aggregation sites are targeted for net removal operations (see 2.03)</p> <p>A review of options for fishing gear marking and tracking.</p> <p>Identify ports as cost effective hubs for ghost net disposal and management, particularly in the Gulf of Carpentaria.</p> <p>Removal of nets circulating and accumulating in the Gulf of Carpentaria near to a strategic port e.g. Weipa.</p>	<p>Through the TAP team.</p>
<p>4.04 Develop understanding on the potential for biological breakdown of plastic to aid in its removal from the marine environment.</p>	<p>Low priority, long term</p>	<p>Determine if there are organisms present in the marine environment that could be manipulated to address accumulations of plastic.</p>	<p>Strategic use of organisms able to biologically breakdown plastic</p>	<p>NESP Marine Biodiversity Hub</p>

Objective 5. Monitor the quantities, origins and hazardous chemical contaminants of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris.

Data collection, management and access are crucial to improving marine debris outcomes. Rigorous data can reveal patterns in debris items and sources, enabling the implementation of source reduction plans and aiding in the identification of cost effective actions. This is especially the case when combined with other relevant data sources (e.g. oceanographic information). It is also important to provide the public with authoritative information, which is based on well managed data.

Understanding of the potential impacts of microplastic chemical contamination is developing. For example, laboratory experiments by Wardrop et al. (2016) found that a form of flame retardant with potential to persist in the environment (polybrominated diphenyl ethers) accumulated in fish tissue after contaminated microbeads sourced from facial soaps were ingested.

International Pellet Watch is a volunteer-based global monitoring program for persistent organic pollutants found on plastic resin pellets. These resin pellets are industrial feedstock of plastic products and can be spilled into the environment during production, packaging, and transportation — they are ubiquitous in the marine environment and on beaches. Resin pellets are persistent in the environment and the hydrophobic nature of the pellets allows for the sorption of hydrophobic organic pollutants, including persistent organic pollutants, from the surrounding environment. Continuous monitoring of persistent organic pollutants is important and is encouraged so as to improve understanding of pollution status, pollutant fates, and the effectiveness of regulation and remediation (Yeo et.al. 2015).

Actions for Objective 5. (Monitor the quantities, origins and hazardous chemical contaminants of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris)

Action	Priority/ timeframe	Outcome	Output	Responsibility
5.01 Continued collection of data in long term beach survey.	Ongoing for the life of the plan	Long term monitoring of the state of the threat (relevant to this TAP, State of the Environment reporting and for efforts such as Australian Packaging Covenant) Improved ability to conduct source reduction planning	Long term datasets from beach survey sites	CSIRO, non-government organisations, volunteers
5.02 Maintain a national database for long term marine debris beach survey data and promote standard methodologies for collecting and ongoing monitoring of beach clean-up debris	High priority/within 1 year of the TAP entering into effect	An accessible information repository for marine debris data	Central data reporting through the Atlas of Living Australia for all agencies or groups that would like to provide input.	Department of the Environment and Energy / NESP working with the Atlas of Living Australia
5.03 Enhanced collection of data related to ghost net retrievals from Commonwealth waters across northern Australia	Ongoing for the life of the plan	Improved ability to conduct source reduction planning in relation to ghost nets Assistance with identification of accumulation zones for ghost nets	Long term datasets on ghost net retrievals from Commonwealth waters across northern Australia, including data on the presence of entangled threatened species.	Department of Environment and Energy working with Australian Government and charter vessel operators
5.04 Continue to monitor persistent organic pollutant using plastic resin pellets from Australian beaches	High priority - Ongoing for the life of the TAP	Publicly available, long term data indicates trends in persistent organic pollutant levels in plastic resin pellets from Australian beaches	Comprehensive Australian data included in International Pellet Watch dataset (www.pelletwatch.org)	Community, Australian, state and territory government

Actions for Objective 5. (Monitor the quantities, origins and hazardous chemical contaminants of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris)

Action	Priority/ timeframe	Outcome	Output	Responsibility
5.05 Assess the effectiveness of Australia's waste management in reducing the levels of plastics entering the marine environment	High priority/within 2 years of the TAP entering into effect	<p>Identified issues and trends in littering, with associated opportunities for reducing litter at source points.</p> <p>Improved ability for making cost effective decisions based upon high quality data from reputable data sources.</p> <p>Pinpointing of key approaches and sites to enhance recycling of packaging away from sources and households.</p> <p>Flow-on effects include a reduction of littering and other solid waste impacts on terrestrial and marine ecosystems.</p>	<p>An investigation of the effectiveness of different government investments in reducing litter moving into the marine environment.</p> <p>Identified littering hot spots and pathways (e.g. stormwater) for litter and other refuse to reach the marine environment.</p>	CSIRO, NESP Marine Hub States and territories
5.06 Regularly conduct assessment of mean surface plastic loads and associated hazardous chemical contaminants across Australian jurisdictions and territories	Ongoing for the life of the TAP	An understanding of the amounts, sources and potential impacts of the most abundant forms of plastic, microplastic and associated hazardous chemical contaminants in Australian waters.	Regular assessment of mean surface plastic loads and associated hazardous chemical contaminants in Australian waters	CSIRO, Australian, state and NT governments, other research providers
5.07 Improved understanding of the impact and origins of ghost nets.	Medium priority, within 6 months of TAP being in place	Improved ghost net data collection through the use of identification kits (with a view to aiding source reduction planning)	<p>Promotion of the use of ghost net identification kits in coastal northern Australia - identification kits are actively promoted through TAP team members to all Australian, state, NT and local governments, ranger and community groups that are involved in ghost net management.</p> <p>Encourage Indigenous communities to continue promotion of the ghost net problem through ghost net art.</p>	TAP team

Objective 6. Increase public understanding of the causes and impacts of marine debris, including microplastic and hazardous chemical contaminants, in order to bring about behaviour change.

Changes in the way people buy, use and dispose of consumer products will play a major role in limiting the impact of marine debris. To achieve this change, consumers need an understanding of both the short and long-term implications of continuing to use and dispose of plastic and other materials in their current form, and at the current rate. Increasing understanding of potential marine food chain and human health impacts from microplastic and contaminants could be a major driver of change in consumer behaviour.

Actions for Objective 6.

Action	Priority/ timeframe	Outcome	Output	Responsibility
6.01 Raise the profile of marine debris impacts on listed threatened marine species.	High priority, throughout the life of the TAP	<p>Community better engaged on the wildlife impacts of consumer products to drive choices that limit marine debris impacts</p> <p>Greater levels of personal responsibility in relation to consumption and waste management</p>	<p>Australian Government social media channels (Threatened Species Commissioner, Commonwealth Marine Reserves, Department of the Environment and Energy, NESP, AMSA) to engage the public on marine debris impact and pollution issues through for example:</p> <ul style="list-style-type: none"> • promotion of marine debris problems identified through source reduction planning — such as helium balloons released at celebrations • outcomes of research into impacts of marine debris on marine species (including any potential human health impacts arising from research into marine microplastic and associated chemical contamination) • promotion of wildlife rescue and rehabilitation efforts for marine species impacted by marine debris 	<p>Department of the Environment and Energy</p> <p>NESP</p> <p>Through existing NGOs, encourage community engagement on marine debris, litter and waste management issues</p>

Actions for Objective 6 (Increase public understanding of the causes and impacts of marine debris, including microplastic and hazardous chemical contaminants, in order to bring about behaviour change).

Action	Priority/ timeframe	Outcome	Output	Responsibility
6.02 Improve public communication in relation to consumer waste and litter	Ongoing for the life of the TAP	Better awareness of consumer impacts on the marine environment	<p>Reinvigorated, nationally consistent communication aimed at preventing litter and improved recycling effort (based around psychological insights into littering behaviour e.g. Spehr and Curnow (2015))</p> <p>Existing litter campaigns are refocused on: microplastic —emphasising that this material can't be removed from the ocean the everyday sources of marine debris e.g. helium balloons released into the environment at celebrations and ceremonies</p> <p>Improved information and labelling on appropriate disposal of degradable and compostable plastics</p> <p>Public education through promotion of major public events as “No Waste Days”</p>	Department of the Environment and Energy, state and territory governments e.g. Keep Australia Beautiful / Clean-up Australia style programs

3 Duration, investment, implementation and evaluation of the plan

3.1 Duration

This threat abatement plan is subject to review within five years. Given the global nature of the marine debris flows and the durability of the materials involved, many of the objectives and actions in this plan will be continue to be valid well beyond the five-year review period.

3.2 Investment in the plan

A threat abatement plan is not linked directly to any Australian Government funding programs. However, the plan helps direct the focus of government funding programs to activities that will help to meet identified actions. While the Australian Government is unable to provide funding to cover all actions in this plan, it is committed to implement the plan to the extent to which it applies in Commonwealth areas, for example, Commonwealth Marine Reserves. Investment in marine debris threat abatement plan actions will be determined by the level of resources that industry, government and community stakeholders commit to management of the problem.

The successful implementation of the actions under this TAP will rely on support from stakeholders. Partnerships involving industry, government and non-government organisations, universities, community groups, Indigenous groups and the community will be key to successfully delivering significant reductions in the threats posed by marine debris. Outlined below are estimated costs of implementation for selected actions within the plan.

Estimated costs of implementation for selected actions

Action	Costs anticipated at the time of TAP development for action items	Estimated total cost across life of the TAP
Agenda and action based meetings of representatives of relevant agencies and organisations (Establish a TAP team to coordinate TAP actions for the life of the plan).	\$50 000 (Staff time for coordination / attendance at meetings)	\$500 000 (coordination of effort and several teleconferences or meetings per year)
1.04 Encourage innovation in recovery and waste treatment technologies	\$200 000 (Consultancy for assessment of the environmental impact and cost effectiveness of the use of waste to energy systems in remote coastal communities and at ports)	\$200 000
1.05 Improve management of ghost nets	\$150 000 (Consultancy / staff time for review of Australia's engagement on abandoned, lost or otherwise discarded fishing gear in the Asia Pacific region – with a determination on the appropriateness of current actions).	\$150 000
3.01. Build understanding related to microplastic pollution (research projects).	\$1 000 000 Identification of an appropriate suite of bio-indicator species (invertebrate and vertebrate) for long term monitoring to measure the impact of marine microplastic plastic debris.	\$5 000 000 (long term monitoring of impact on indicator species).
5.03 Establish and maintain a national data set on marine debris, through the Atlas of Living Australia.	\$100 000 (staff time/ resources for 6 months)	\$200 000 (annual data maintenance approx. \$10 000 per year).

It should be noted that substantial volunteer effort on marine debris removal, monitoring and communication has resulted in valuable outcomes, for minimal investment.

Tangaroa Blue Foundation estimated the real average cost per kilometre of its volunteer based beach clean activities in New South Wales and Queensland (2014 figures, below). These figures assume an hourly rate of \$30 per hour, per person rather than the use of volunteer labour. They indicate the high cost of even the most fundamental action to address marine debris.

Estimated average cost per kilometre of beach cleaned (Tangaroa Blue)

Type of site	NSW (\$)	QLD (\$)
Within populated areas	1,109.53	842.96
Away from populated areas	559.85	2,080.47
Inland waterways	1,878.57	1,140.25
State average	1,182.65	1,354.56
Remote sites (e.g. Cape York Peninsula)		7,687.32

Due to the entrenched and pervasive nature of the problem, investments in marine debris threat abatement action are likely to be long term and costly. Economic returns on such investment are possible (through retrieval of resources or energy from debris material), but are likely to remain small, at least for the life of this plan.

Waste to energy systems involve high infrastructure costs, but allow for waste (potentially including retrieved marine debris) to be valued as a commodity. This waste management option is being pursued in Western Australia, with the planned development of two waste to energy facilities at the City of Kwinana, south of Perth and Boodarie in the Pilbara. Costs for development of these facilities are \$400 million and \$200 million respectively:

3.3 Links to legislation and to Australian Government plans and programs

This TAP sits within the context of national legislation, policy and programs directed to the long term preservation of Australia's biodiversity. The TAP is a legislative instrument under the EPBC Act, Australia's central piece of environmental legislation. EPBC Act listed threatened species that have been documented as impacted by marine debris are shown at **Appendix A**, and the single threatened ecological community identified as impacted by marine debris (litter) is shown at **Appendix B**. Relevant recovery plans that have been prepared to guide the recovery of EPBC Act listed threatened species are shown at **Appendix C**.

The Reef 2050 Plan is the overarching framework for protecting and managing the Great Barrier Reef from 2015 to 2050. The Reef Trust is one of the key mechanisms assisting in the delivery of the Reef 2050 Plan, investing in the mitigation of known key threats to the Reef. The Reef Trust has a strong focus on evaluation and adaptive management, aimed at ensuring the long-term sustainable management of the Great Barrier Reef.

Australian Government funding for scientific research or management actions in line with the objectives and actions of this TAP may be possible. The National Environmental Science Programme provides a long-term commitment to environment and climate research through six research hubs (including the Marine Biodiversity Hub and Tropical Water Quality Hub).

The Australian Government's Threatened Species Strategy provides a broad framework for science, action and partnership to achieve Australia's long-term goal of reversing species declines and supporting species recovery.

State and Commonwealth legislation is in place to implement Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL). This occurs through the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*.

3.4 Evaluating implementation of the plan

Section 279 of the EPBC Act provides for the review of action under this TAP at any time and requires that the TAP be reviewed at intervals of no longer than five years. The review will examine action under the TAP and assess if the TAP's objectives have been met. Its recommendations will form the basis of a revised plan, if required.

Regular six-monthly meetings of the TAP working group will help ensure that progress is monitored and implementation of the plan is progressed.

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EPBC Act listed species adversely impacted by marine debris

Type	Common name	Scientific name	EPBC Act status	Identified in key threatening process listing or other reference
Turtles	Flatback turtle	<i>Natator depressus</i>	Vulnerable Marine Migratory	Identified in KTP listing
	Green turtle	<i>Chelonia mydas</i>	Vulnerable Marine Migratory	Identified in KTP listing
	Hawksbill turtle	<i>Eretmochelys imbricata</i>	Vulnerable Marine Migratory	Identified in KTP listing
	Leatherback turtle	<i>Dermochelys coriacea</i>	Endangered Marine Migratory	Identified in KTP listing
	Loggerhead turtle	<i>Caretta caretta</i>	Endangered Marine Migratory	Identified in KTP listing
	Olive ridley turtle	<i>Lepidochelys olivacea</i>	Endangered Marine Migratory	Schuyler et. al. (2016)
Cetaceans	Blue whale	<i>Balaenoptera musculus</i>	Endangered Cetacean Migratory	Identified in KTP listing
	Bryde's whale	<i>Balaenoptera edeni</i>	Cetacean Migratory	Department of Environment and Energy (2016)
	Fin whale	<i>Balaenoptera physalus</i>	Vulnerable Cetacean Migratory	Bannister et al. (1996)
	Humpback whale	<i>Megaptera novaeangliae</i>	Mulnerable Cetacean Migratory	Identified in KTP listing, Besseling et al. (2015)
	Sei whale	<i>Balaenoptera borealis</i>	Vulnerable Cetacean Migratory	Bannister et al. (1996)
	Southern right whale	<i>Eubalaena australis</i>	Endangered Cetacean Migratory	Identified in KTP listing

Type	Common name	Scientific name	EPBC Act status	Identified in key threatening process listing
Sharks	Grey nurse shark (west coast population)	<i>Carcharias taurus</i>	Vulnerable	Identified in KTP listing
	Grey nurse shark (east coast population)	<i>Carcharias taurus</i>	Critically endangered	Identified in KTP listing
	Silky Shark	<i>Carcharhinus falciformis</i>	Migratory	Filmalter et al. (2013)
Birds	Antipodean albatross	<i>Diomedea exulans antipodensis</i>	Vulnerable Marine Migratory	Identified in KTP listing
	Black-browed albatross	<i>Thalassarche melanophris</i>	Vulnerable Marine Migratory	Jiménez et al. (2015)
	Buller's albatross	<i>Thalassarche bulleri</i>	Vulnerable Marine Migratory	Roman et al. (2016)
	Gibson's albatross	<i>Diomedea exulans gibsoni</i>	Vulnerable Marine Migratory	Identified in KTP listing
	Grey-headed albatross	<i>Thalassarche chrysostoma</i>	Endangered Marine Migratory	Identified in KTP listing
	Indian yellow-nosed albatross	<i>Thalassarche carteri</i>	Vulnerable Marine Migratory	Identified in KTP listing
	Northern royal albatross	<i>Diomedea epomophora sanfordi</i>	Endangered Marine Migratory	Identified in KTP listing
	Shy albatross	<i>Thalassarche cauta</i>	Vulnerable Marine Migratory	Roman et al. (2016)
	Southern royal albatross	<i>Diomedea epomophora epomophora</i>	Vulnerable Marine Migratory	Identified in KTP listing
	Tristan albatross	<i>Diomedea exulans exulans</i>	Endangered Marine Migratory	Identified in KTP listing
	Wandering albatross	<i>Diomedea exulans</i> (sensu lato)	Vulnerable Marine Migratory	Identified in KTP listing
	Blue petrel	<i>Halobaena caerulea</i>	Vulnerable Marine	Identified in KTP listing
Antarctic prion	<i>Pachyptila desolata</i>	Marine	Roman, et al. (2016)	

Type	Common name	Scientific name	EPBC Act status	Identified in key threatening process listing or other reference
Birds (continued)	Fairy prion (southern)	<i>Pachyptila turtur subantarctica</i>	Vulnerable Marine	Gregory (2009) Roman, et al. (2016)
	Salvin's prion	<i>Pachyptila salvini</i>	Marine	Roman, et al. (2016)
	Slender-billed prion	<i>Pachyptila belcheri</i>	Marine	Roman, et al. (2016)
	Gould's petrel	<i>Pterodroma leucoptera leucoptera</i>	Endangered Marine	Identified in KTP listing Roman et al. (2016)
	Northern giant petrel	<i>Macronectes halli</i>	Vulnerable Marine Migratory	Identified in KTP listing
	Southern giant petrel	<i>Macronectes giganteus</i>	Endangered Marine Migratory	Roman et al. (2016) Tourinho et al. (2010)
	Westland petrel	<i>Procellaria westlandica</i>	Marine Migratory	Roman et al. (2016)
	Pelican	<i>Pelecanus conspicillatus</i>	Marine	Sloan et al. (1998) Roman, et al. (2016)
	Kelp gull	<i>Larus dominicanus</i>	Marine	Yorio et al. (2014)
	Little shearwater	<i>Puffinus assimilis</i>	Marine	Roman et al. (2016)
	Flesh-footed shearwater	<i>Puffinus carneipes / Ardenna carneipes</i>	Marine Migratory	Lavers et al. (2014)
	Fluttering shearwater	<i>Puffinus gavia</i>	Marine	Roman et al. (2016)
	Short-tailed Shearwater	<i>Ardenna tenuirostris</i>	Marine Migratory	Carey (2011) Roman et al. (2016)
	Wedge-tailed shearwater	<i>Ardenna pacifica</i>	Marine Migratory	Roman et al. (2016)
	Wilson's storm-petrel	<i>Oceanites oceanicus</i>	Marine Migratory	van Franeker (1988)
	Silver Gull	<i>Chroicocephalus novaehollandiae</i>	Marine	Roman et al. (2016)

Type	Common name	Scientific name	EPBC Act status	Identified in key threatening process listing or other
Other	Australian sea lion	<i>Neophoca cinerea</i>	Vulnerable Marine	Page et al. (2004)
	Seals		Marine	Pemberton et al. (1992)
	Dugong	<i>Dugong dugon</i>	Marine Migratory	EPA (2000)
	Australian fur seals	<i>Arctocephalus pusillus doriferus</i>	Marine	Lawson, et al. (2015)
	Elegant Seasnake	<i>Hydrophis elegans</i>	Marine	Udyawer, et al (2013)

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Threatened ecological community adversely impacted by marine debris

Community name	Current status	EPBC Act listing advice	Recovery Plan Decision
<p><i>Posidonia australis</i> seagrass meadows of the Manning-Hawkesbury ecoregion (Effective 07 May 2015).</p>	<p>Listed as Endangered</p>	<p>Catchment disturbance and pollution - The ecological community is impacted by increased inputs from a range of pollutants associated with catchment disturbance including sediment, nutrients, metals, hydrocarbons, industrial compounds and litter to the associated estuary.</p>	<p>Recovery Plan not required, whilst there is no state recovery plan across the full distribution of the ecological community there are existing catchment and estuary management plans and other planning documents relating to the recovery of ecological community. Taking into account the protection from EPBC listing, recovery and threat abatement priorities and actions specified in this Conservation Advice and the existing management and other plans, a recovery plan for the ecological community is not recommended at this time. (Department of the Environment 2015)</p>

Relevant EPBC Act Recovery Plans

- Conservation Management Plan for the Blue Whale (2015–2025): A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 Commonwealth of Australia, 2015.
- Conservation Management Plan for the Southern Right Whale (2011–2021): A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 Commonwealth of Australia 2012
- Recovery plan for marine turtles in Australia, Environment Australia, 2003
- Lord Howe Island Biodiversity Management Plan, Department of Environment and Climate Change (NSW), 2007
- National Recovery Plan for threatened albatrosses and petrels: 2011-2016, Department of Sustainability, Environment, Water, Population and Communities, 2011
- Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*), Commonwealth of Australia, 2013
- Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*), Commonwealth of Australia, 2014
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