SOUTHERN CROSS UNIVERSITY

SCHOOL OF ENVIRONMENTAL SCIENCE AND MANAGEMENT

AN EVALUATION OF RECENT TRIALS ON "ENVIRONMENTALLY-FRIENDLY" MOORINGS (EFMs), TO INFORM THE DEVELOPMENT OF POLICY IN NEW SOUTH WALES (NSW)

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An evaluation of recent trials on "environmentally-friendly" moorings (EFMs), to inform the development of policy in New South Wales (NSW)

Prepared by Nathan Outerbridge

(Bowman, 2008)

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ABSTRACT

The scouring and fragmentation of seagrass meadows by traditional block & chain moorings (BCMs) is an issue of great concern facing Australia. Approximately 50% of seagrass meadows have been lost in NSW (Bowman, 2008); block and chain moorings are not the major cause of this, however they do result in significant habitat loss for juvenile fish and benthic fauna (Stewart & Fairfull, 2007), and widespread fragmentation of seagrass meadows (Demers et al., 2013). Whilst seagrass species such as Zostera and Halophila generally recover well after disturbance, other species such as Posidonia australis, which has six endangered populations in NSW, are very slow to grow and may take a long time to regenerate (Demers et al., 2013). State Governments, including NSW, and the scientific community, have recently conducted EFM trials to determine the feasibility of using 'environmentally-friendly' moorings as an alternative to traditional BCMs. Results from the trials were generally very positive for EFMs, with seagrass recovery occurring in most previously scoured areas; benthic fauna also recovered (Gladstone 2010b; DEEDI, 2011; Gladstone, 2011; Demers et al., 2013). The Seagrass Friendly Mooring (SFM) design proved to be the most reliable and effective during the EFM trials; the Seaflex and EzyRider designs also produced positive results in terms of seagrass recovery, however they were prone to more technical issues; suppliers have worked to resolve these issues by refining the designs (DEEDI, 2011). Cyclone moorings created significant scouring and therefore the current design is unsuitable (Hastings et al., 1995; Demers et al., 2013).

A questionnaire was developed for key stakeholders with the purpose of identifying important issues and to plan the future direction of EFMs and a policy position in NSW. Costs for EFMs can be reduced by increasing awareness about their benefits and therefore uptake will rise, increasing Government support for the industry and the creation an EFM policy position, introducing environmental standards for all moorings and increasing suppliers and trained contractors. Technical issues can be overcome through further design refinement, trials and increased maintenance. Supply can be made more efficient by expanding the EFM industry, creating competition, quicker responsiveness and increasing qualified contractors, and the prevention of a monopoly. Stakeholders agree that EFMs are an effective alternative to BCMs. A moratorium should be introduced through an EFM policy to prevent the ongoing use of BCMs, with possible incentives to replace existing moorings. Future trials should incorporate better communication with boating stakeholders, increased control sites and BCMs, training of participants, EFM strength testing, increased EFM sampling sizes and testing in new wind, wave and light scenarios.

Keywords: *Environmentally-friendly Moorings (EFMs), Block & Chain Moorings (BCMs), Seagrass Friendly Moorings (SFMs), Seaflex Moorings, EzyRider Moorings, Cyclone Moorings, Seagrass, Scouring, Trials, NSW Policy Position*

CONTENTS

List of Tables

List of Figures

1 Literature Review

1.1 Importance of Seagrass – Nationally and Internationally

Seagrasses are one of the most important coastal habitats worldwide due to their richness and ability to support a diversity of estuarine and marine fauna species, from all tropic levels (Shafer, 2002; Biological Conservation, 2011; Demers et al., 2013). Scientists conservatively estimate that the total area of seagrass worldwide is approximately 177,000 sq. km (Bostrom et al., 2006). From 1985 to 1995 there was an estimated loss of 12,000 sq. km worldwide due to anthropogenic impacts including commercial and recreational fishing, dredging and reclamation, foreshore development, stormwater and traditional block & chain moorings (Bostrom, 2006). In Australia, seagrass beds cover approximately 51,000 sq. km and are the most diverse in the world with 38 species found in coastal waters from a total of 66 species worldwide (Kirkman, 1997; McComb & Dennison, 1999; Gladstone, 2009). This high diversity is due to the overlap of tropical and temperate zones and geomorphic characteristics of the Australian coastline, which provides large geographic regions for seagrasses to inhabit. There are also a high number of species endemic to their bioregion; these are areas with unique natural features and environmental processes (Zann, 1996; Curruthers et al., 2002).

Seagrasses provide numerous ecological services, including significant biodiversity, production of fish stocks, stabilization of sediments etc. It is estimated that approximately 40 times more animals are likely to occur in areas covered by seagrass meadows compared with areas of bare sand (McKenzie, 2008). Many juvenile and adult fish species use seagrass beds as nursery habitat, including recreationally and commercially important fish stocks including perch, mullet, luderick, leatherjacket, whiting, sweetlip, emperor, bream, snapper and tailor (Kirkman, 1997; Stewart & Fairfull, 2007; McKenzie, 2008). Important commercial shellfish and crustacean species also rely on seagrass as a key habitat; including prawns, rock lobsters, oysters and pearl shells (McKenzie, 2008). The importance of seagrass as a key habitat is clearly evident in the Gulf of Carpentaria, where a loss of approximately 183 sq. km of seagrass has resulted in the loss of between 250 and 300 tonnes per year of the tiger prawn fishery (Kirkman, 1997).

In relation to water quality and carbon sequestration, seagrass meadows contribute to organic carbon production and storage, the cycling of nutrients, erosion control and sediment filtration (Orth et al., 2006; Stewart and Fairfull, 2007). Seagrass plants have strap-like leaves which help to impede suspended solids by slowing the flow of the water (baffle effect) allowing the sediment to settle out (Kirkman, 1997; McKenzie, 2007; Stewart and Fairfull, 2007). This results in improved water quality and clarity (McKenzie, 2008). Seagrass meadows usually contain rhizome networks which help to secure the underlying sediment and prevent its erosion, adding to improved water quality outcomes (McKenzie, 2008). Without these rhizomes many beaches, channels and sandy bottoms would be threatened by erosion (Kirkman, 1997). Seagrass is also an important blue carbon sink because it is able to sequester and store carbon in its sediments and biomass at greater levels than that of tropical forests, and for a much longer residency period (Lawrence et al., 2012).

Seagrass meadows assist in the cycling of nutrients. After sediments have been trapped in seagrass meadows the matted root systems of seagrass absorb nitrogen and phosphorous, which helps to filter and buffer chemicals entering the ecosystem (McKenzie, 2007; McKenzie, 2008). Without the presence of seagrass beds, these nutrients may concentrate and result in algal blooms and reduced water quality in coastal areas (McKenzie, 2008). Epiphytes often grow on the fronds of seagrass and they also filter the water quality (Stewart and Fairfull, 2007).

The leaves, stems and epiphytes of seagrass are vital food sources for many marine species (Stewart and Fairfull, 2007). When plant material and epiphytes become discarded, they are usually broken up by bacteria and fungi, and the movement of the waves, which provides food for flagellates and plankton (Stewart and Fairfull, 2007; McKenzie, 2008; Gartner, n.d.). These microorganisms produce food for many juvenile marine animals, such as fish, crabs, prawns and molluscs (Umwelt, n.d.; McKenzie, 2008). Detritivores form the base of the food web and seagrass is an integral part of their diet (McKenzie, 2008), for example the commercially important western rock lobster forages on seagrass detritus and plant material (McArthur et al., 2007). During storms old leaves and epiphytes are removed and replaced with new ones; this high turnover supports the replenishment of the food web (Stewart and Fairfull, 2007). Seagrass meadows in the tropics are grazed upon by larger animals, including the dugong (*Dugong dugon*) and green sea turtle (*Chelonia mydas*) (McArthur et al., 2007; McKenzie, 2008).

1.2 Status of Seagrass in NSW

Seagrass is currently protected in NSW under the NSW Fisheries Management Act 1994 (FM Act). The FM Act states that marine vegetation, which includes seagrass, cannot be harmed by a person without first seeking the authority of a permit that is issued by the Minister (NSW legislation, 2012). The term 'harm' under Part 7 of the FM Act can refer to "gather, cut, pull up, destroy, poison, dig up, remove, injure, prevent light from reaching or otherwise harm the marine vegetation, or any part of it" (Fairfull, 2013).

Protecting 'key fish habitats', is one of the key objects of the FM Act. The NSW Department of Primary Industries (DPI) has defined these habitats in the *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management* (2013), by classifying fish habitats according to their sensitivity, with TYPE 1 considered highly sensitive 'key fish habitat' (Fairfull, 2013). The TYPE 1 category includes *Posidonia australis* (strapweed) and *Zostera, Heterozostera, Halophila and Ruppia* species of seagrass beds >5m^2 in area (section 3.2.1 of the Policy and Guidelines) (Fairfull, 2013). The TYPE 2 category includes *Zostera*, *Heterozostera, Halophila* and *Ruppia* species of seagrass beds <5m^2 in area. Fairfull (2013) outlines the policies and guidelines that apply to any activities that are likely to affect "key fish habitats" including seagrasses. The NSW DPI encourages all proponents to firstly plan their activities around 'key fish habitats', so that long term impacts are avoided. If key seagrass habitats cannot be avoided, or it is impractical to make alternative plans, the damage should be minimized to prevent long term damage, or offset to compensate for any permanent change. Proposals that potentially harm seagrass meadows require approval from NSW DPI (Fisheries NSW) under Parts 4 (integrated development assessment) and 5 of the *Environmental Planning and Assessment Act 1979 (EP&A Act)* unless they are regulated under the State Significant Development or Infrastructure provisions of the EP&A Act (Fairfull, 2013).

The seagrass *Posidonia australis*, which is known as strapweed, grows in the temperate marine and estuarine waters of the lower half of Australia, and it is endemic to these regions (Fairfull, 2013). The areas in NSW where *Posidonia australis* prefers to grow include protected areas, such as coastal bays, estuaries and coastal lakes; regular tidal flushing is an important requirement (Fairfull, 2013). Six populations of *Posidonia australis* have been listed as "endangered" in NSW under the threatened species schedules of the FM Act. These populations are located in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (FSC, 2010). They have been listed due to a range of factors as outlined in the Fisheries Scientific Committee's Final Determination (FSC, 2010) including (briefly describe). *Posidonia australis* is classified as TYPE 1 highly sensitive fish habitat by the NSW DPI in Fairfull (2013), because once it has been removed from an area it rarely regenerates, or at an extremely slow rate. *Posidonia* is more susceptible than other seagrass species because individual plants develop very slowly, fruit and seeds are dispersed at low levels, and meadows usually expand slowly (FSC, 2010). The rhizomes of *Posidonia* may only grow a few millimetres per year in small vulnerable meadows, or in meadows that are larger and more stable the growth can be up to 25cm a year (West, 2011). Research suggests that the large established meadows in NSW, which are > 1 km^2, may have taken decades or even centuries to reach their current size (West, 2011). The NSW DPI will not usually approve works if they harm *Posidonia australis* (Fairfull, 2013). *Posidonia australis* is also protected in several marine parks and aquatic reserves, including Jervis Bay Marine Park, Batemans Marine Park, Towra Point Aquatic Reserve, and Port Stephens-Great Lakes Marine Park (FSC, 2010); however it continues to be threatened in NSW.

1.3 Key Threats – Past and Current

Historically the value of seagrass in Australia has largely been overlooked, and as a result large areas of seagrass habitat have been destroyed; NSW has lost approximately 50% of its seagrass meadows (Bowman, 2008). Threats include runoff from sediments and nutrients, invasive species, diseases, physical disturbances (dredging and reclamation), poor practice from commercial fishing, boating impacts (anchoring, propellers, moorings), algal blooms and climate change (Zann, 1996; Orth et al., 2006; Stewart & Fairfull, 2007; Gladstone, 2009).

1.3.1 Commercial and Recreational Fishing

Commercial and recreational fishing can threaten seagrass habitats if poor practice is adopted. Seagrass can suffer physical damage from trawling and hauling gear, the collection of wrack (dead seagrass) floating on the surface, boat propellers, moorings and anchor damage (Carlo & McKenzie, 2011). Plants are also harmed as a result of boats, vehicles, and human foot traffic (Carlo & McKenzie, 2011).

1.3.2 Dredging and Reclamation

Reclamation is a major threat to seagrass communities in NSW. It includes draining, infilling, or clearing of land so that it can then be developed (Carlo & McKenzie, 2011; NSW DPI, 2013). Reclamation often destroys aquatic habitats, such as seagrass, or results in long term changes to tidal ranges, river flow, water quantity and quality (NSW DPI, 2013). Dredging usually occurs to improve navigation in estuaries and rivers, to alter the flow of water, to install pipelines and cables, and to gather required supplies of sand and gravel (Carlo & McKenzie, 2011; NSW DPI, 2013). Seagrass meadows can be threatened directly from dredging and indirectly through increased turbidity which reduces the amount of sunlight that will reach the plants, limiting their ability to photosynthesise (McKenzie, 2008; Carlo & McKenzie, 2011). The growth of seagrass may also be affected by the increased turbidity and sedimentation, which can smother the plants (Carlo & McKenzie, 2011; NSW DPI, 2013). Dredging can alter the tidal prism in an estuary, therefore changing the environmental conditions which may limit the ability for seagrasses to regenerate.

1.3.3 Foreshore Development

Foreshore development for the construction of infrastructure along the coast can involve permanently clearing seagrass meadows (e.g. cables, pipelines) or indirect impacts (e.g. shading from bridges, marinas, jetties) (Carlo & McKenzie, 2011; NSW DPI, 2013). The development of coastal areas can result in increased runoff, sedimentation and widespread pollution which will ultimately enter seagrass communities and affect the plants and associated organisms (Bell et al., 2001; Carlo & McKenzie, 2011; NSW DPI, 2013). Increased waterway infrastructure can also lead to greater access and numbers of boats and vehicles utilising coastal areas, affecting seagrass communities. Oil from these can leak or be washed into waterways where it is toxic to seagrass and can limit growth (McDowell et al., 2009; Carlo & McKenzie, 2011). Erosion will increase due to the destabilisation of soil, which will increase turbidity and sedimentation (Carlo & McKenzie, 2011).

1.3.4 Stormwater

Stormwater runoff, or runoff from industrial and urban areas, sewerage leaks or spills and runoff from agriculture land, can result in high levels of nutrients entering the water (McDowell et al., 2009). High nutrient levels affect the growth of seagrass by creating algal blooms (McDowell et al., 2009). The algae will either be free floating, which increases the turbidity of the water, or it can be epiphytic algae, which attach to leaves and stems of the seagrass. The cumulative effect will be a reduction in the diffusion of nutrients and gases to the leaves, increased shade, which will limit photosynthesis, and there will be an increase in weight for the seagrass leaves (McKenzie, 2008; McDowell et al., 2009). Toxicants, including herbicides and heavy metals such as lead, copper, zinc and cadmium, can accumulate in sediments and bio-accumulate in the organisms which inhabit seagrass meadows (Environment Protection Agency, 1998). Whilst concentration of these toxicants has been shown to be low in the seagrass plants, seagrass communities may be impacted indirectly (Environment Protection Agency, 1998).

1.3.5 Traditional Block & Chain Moorings

Permanent boat moorings are highly concentrated in the world's embayments and therefore they are considered one of the major causes of physical disturbances to seagrass (Demers et al. 2013). Traditional block and chain moorings, illustrated in Figure 1, have contributed to the decline of seagrass in Australia. Seagrass is damaged when the slackened chain from the mooring drags along the seabed during low tide (Gladstone, 2009).This process over time tears seagrass out by the roots, which subsequently leads to a scoured circular area where the chain has been dragging, shown in Figure 2. Benthic fauna is also disrupted during this process (Bowman, 2008; DEEDI, 2011; West, 2011). Undamaged seagrass meadows are able to absorb and regulate the energy of the current and waves (Bowman, 2008). If a seagrass meadow is fragmented through continued disturbance then it is much more likely to experience significant erosion and future loss. Scoured areas will continue to expand down-current and combine with other barren areas (Bowman, 2008). A number of environmentally friendly moorings (EFMs) have been designed to overcome some of the issues associated with traditional BCMs.

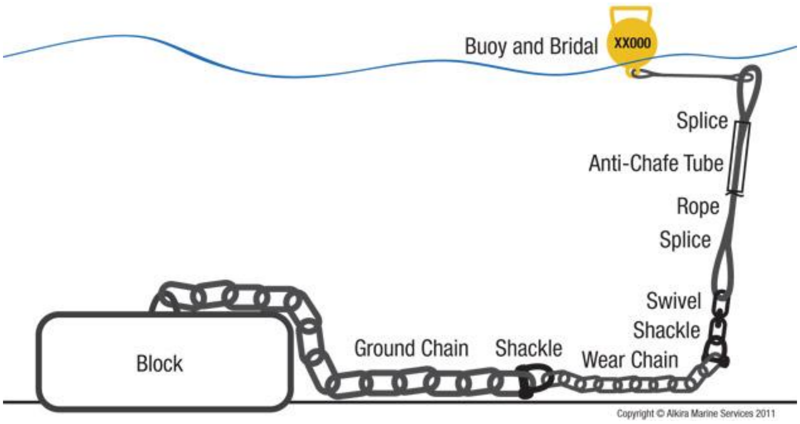

Figure 1: The major parts of a traditional block & chain mooring (Alkira Marine Services, 2013).

Figure 2: Block & chain moorings showing chains dragging on the seabed and barren areas where seagrass has been scoured (Gladstone, 2009).

1.4 Design and Costing of Traditional Block and Chain Moorings

A basic traditional block and chain mooring, suited for most vessels, generally consists of a 1 tonne concrete block, 3-6m of 35mm+ stud link ground chain, a 20mm custom fabricated swivel, 2.5m of 16mm mild steel chain, a 24mm silver rope protected at both ends by a heavy duty anti chaff plastic sleave, and a NSW Roads and Maritime Services approved buoy and numbering with 12mm hook-up line (Bowline Marine, 2013). Approximate prices for 2013 are:

- Single Block mooring (vessels 18-32 foot) $935 inc GST
- Double Block mooring (vessels 32-45 foot) $1485 inc GST
- Fore & aft moorings (vessels 18-40 foot) $1540 inc GST (Bowline marine, 2013).

1.5 Environmentally Friendly Mooring Designs

1.5.1 Seagrass Friendly Mooring Systems

These moorings are screwed into the seabed via a screw helix or 'auger' **(**DEEDI, 2011; On Water Maine Services, 2013; SEQ Catchments, 2013). Load spreaders are attached to a central mooring post and are located just below the surface of the seabed. The top of the mooring post is attached to a swivel head and shock absorber, which is connected to a hawser rope, which joins to the surface buoy **(**DEEDI, 2011; On Water Maine Services, 2013; SEQ Catchments, 2013). The goal of this design is to ensure that there is minimal contact with the seafloor and seagrass, so that dragging and scouring is avoided (Seagrass-Watch, 2010; On Water Maine Services, 2013; SEQ Catchments, 2013) as demonstrated in Figure 3. A small area of the seabed may be disturbed during installation, however after the mooring is fully installed the movable arm of the seagrass friendly mooring (SFM) is designed not to touch the seabed at any stage of the tide, to protect and allow for the recovery of seagrasses and benthic fauna (Seagrass-Watch, 2010). For 2013, installation and supply costs in NSW are approximately $2,500 + GST, and the annual service cost is approximately $300 per year + GST (Maslen, D. Seagrass Friendly Mooring Designer/ Supplier, 2013, pers. comm.).

Figure 3: The SFM is screwed into the seabed to prevent dragging and the movable arm does not drag on the seabed at any stage of the tide, this prevents scouring of seagrass around the mooring (SIMS, n.d.).

1.5.2 EzyRider

The base of this mooring is either a concrete block/s or plate (the plate is driven into the seafloor with steel pins) (DEEDI, 2011; EzyRider Mooring, 2013). Three chains are connected to the base, which creates a tripod; known as the Offset Anchor System. The Anchoring System is attached to a single coil chain that is link proof. The chain is then connected to the mooring buoy using a steel shaft (DEEDI, 2011; EzyRider Mooring, 2013) as shown in Figure 4. Strong rubbers are positioned from the bottom of the buoy to the base of the shaft, which absorbs movement and keeps the chain from dragging on the seabed; known as the Advanced Mooring Technology (DEEDI, 2011; EzyRider Mooring, 2013). Pricing for the system is currently not available.

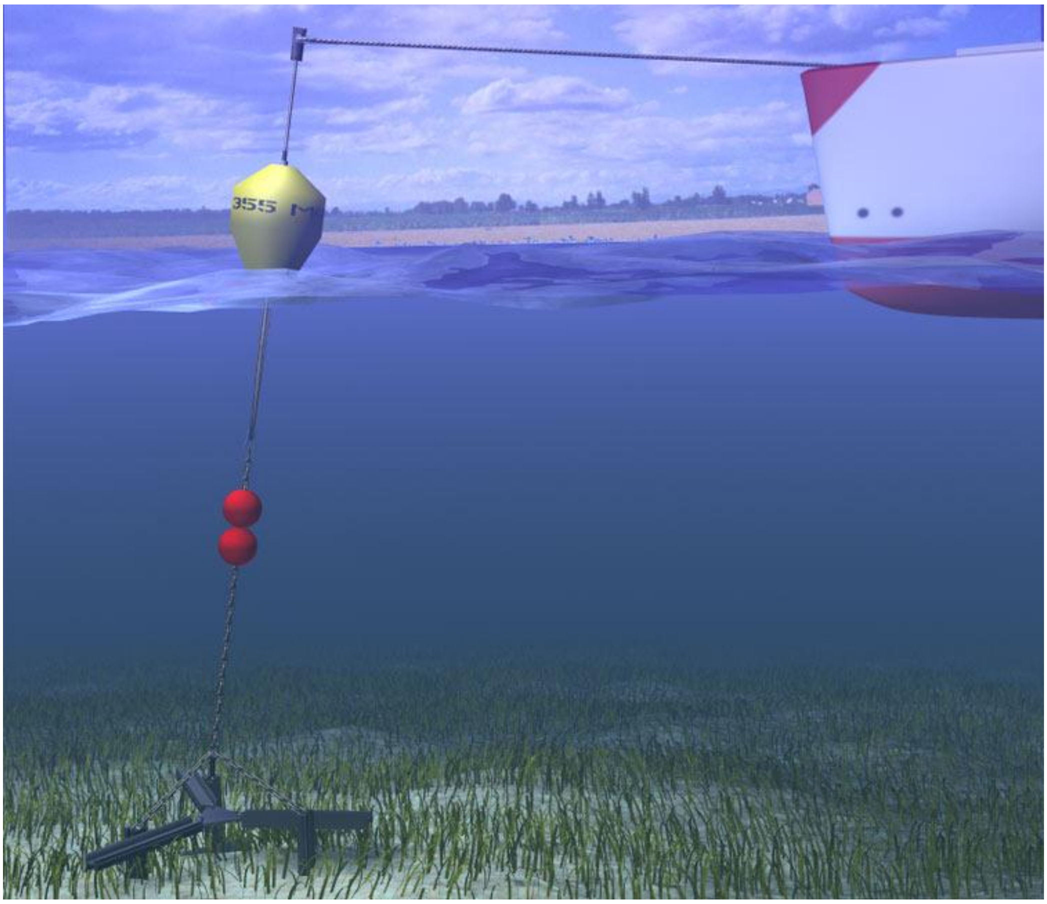

Figure 4: The major parts of an EzyRider mooring. Seagrass is able to grow around the base of the mooring because it is fixed and the chain is kept of the seabed (EzyRider mooring, 2013).

1.5.3 Seaflex

Seaflex moorings are designed with an elastic system which will secure pontoons and buoys in position (DEEDI, 2011; Seaflex AB, 2013) as shown in Figure 5. The system has been designed to resist corrosion in marine environments, resulting in less maintenance over time and should not scour or damage seagrass meadows and disrupt benthic fauna (Seaflex AB, 2013). Seaflex moorings will adjust to variations in tides and wave action by slowly stretching (becoming elongate) and then returning to a more constant and smoother movement **(**DEEDI, 2011; Seaflex AB, 2013; Whitsunday Moorings & Marine Constructions, 2013). This progressive resistance to any changes in wave action occurs both in the lateral and vertical planes, the design also includes a pretention (Seaflex AB, 2013). This mooring can withstand any weather conditions (Seaflex AB, 2013). The size of the Seaflex mooring required is determined using the JFlex software developed by the designer, which includes analysing water level variations, wind, waves, current, depth and air resistance caused by boats (Seaflex AB, 2013). Navigation buoys are more likely to remain in position with a Seaflex mooring compared with a traditional mooring (Seaflex AB, 2013). Prices start from approximately $530 (400 EUR) for small units and increases for larger units. Installation is approximately 10% of the total project cost (Brandt, L. Sales/ Supplier, 2013, pers. comm.).

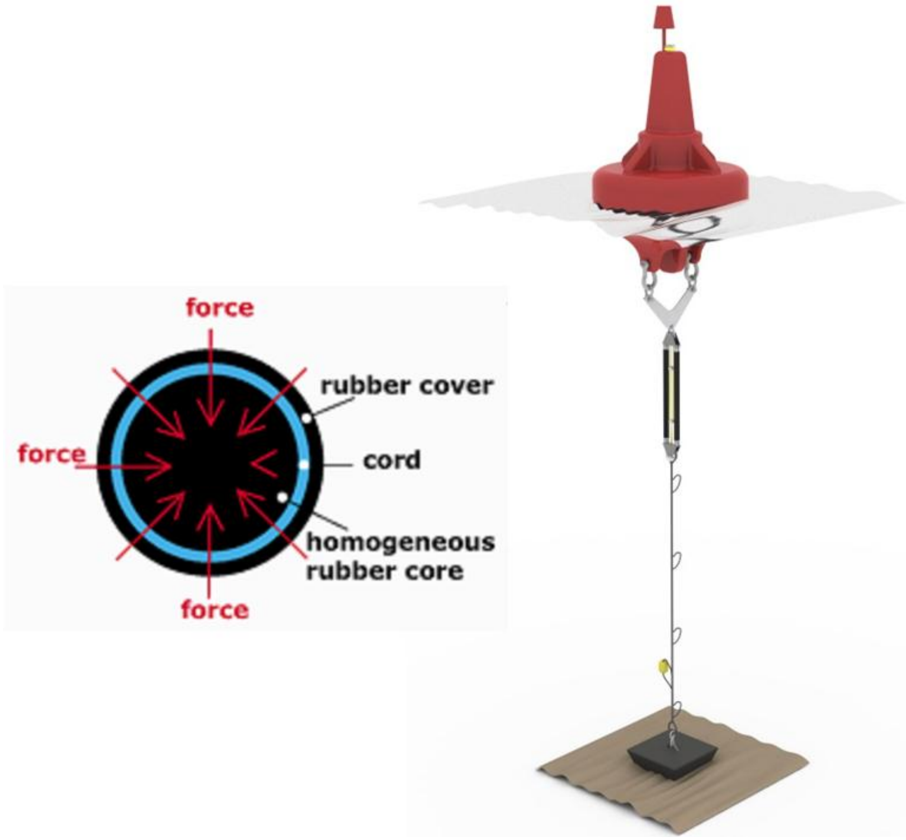

Figure 5: Shows how the elastic system of the Seaflex mooring works by absorbing energy in the water, and what the Seaflex mooring will look like once installed (Seaflex AB, 2013).

1.5.4 Eco Friendly Mooring

The Eco Mooring helix anchor is designed and built in America and imported to Australia (Waters Marine, 2013).This design has been tested in adverse conditions, including the South Pacific and Iceland (Waters Marine, 2013). The helix anchor is screwed into the seabed to prevent dragging even during severe storms (Waters Marine, 2013) as shown in Figure 6. The helix anchor is galvanized and can be fitted to most bottom types. It has been engineered to withstand the force of an 800hp tug boat and can hold up to 20,000 lbs. (Waters Marine, 2013). The rode of the eco mooring has an elastic core, which will stretch in response to changing tides and wave motion. This rubber core has an exterior multi strand rope as a failsafe (Waters Marine, 2013). The cost of an Eco friendly mooring for 2013 is approximately $3000 + GST for most vessels (Waters, J. Supplier, 2013, pers. comm.) This includes an anchor (1 ½ inch shaft), chain floats and Eco-rode. Moorings for larger and smaller boats are also available (Waters, J. Supplier, 2013, pers. comm.).

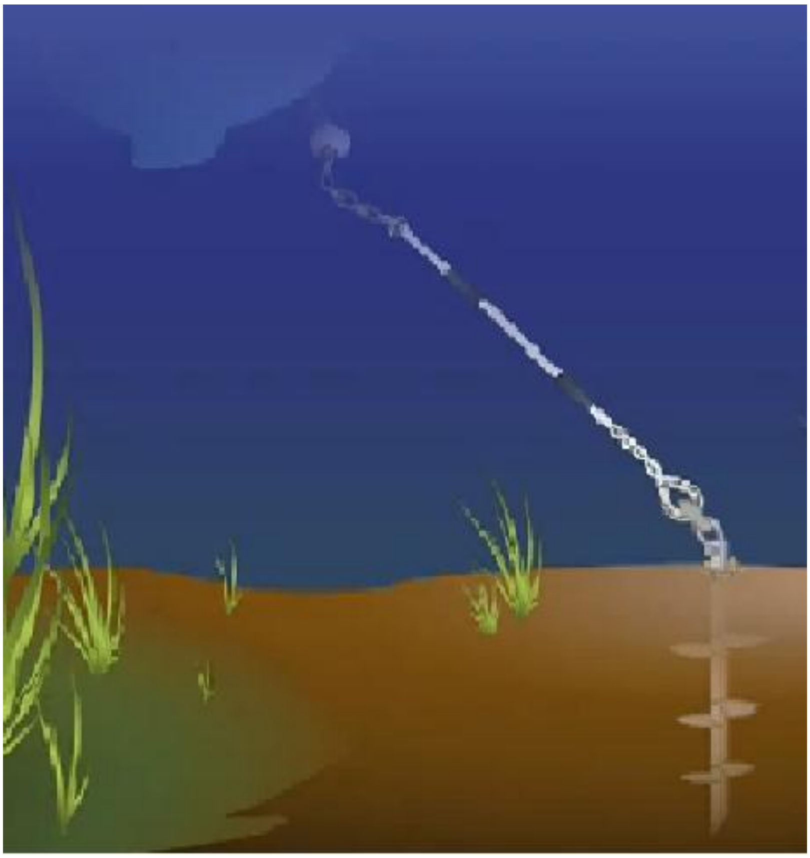

Figure 6: The helix anchor of the Eco Mooring is screwed into the seabed, which prevents the vessel dragging the mooring (BoatMoorings.com, 2013).

1.5.5 Jeyco Mooring

This design uses an anchor to secure three chains (this forms a tripod) (Jeyco, 2013); as shown in Figure 7. Moorings are available for either recreational or commercial use and they have been designed and engineered to cope with large storms and cyclones (Jeyco, 2013). Once secured to the seabed there shouldn't be any dragging as a result of variations in tides and wave motion (Jeyco, 2013); Pricing is currently not available.

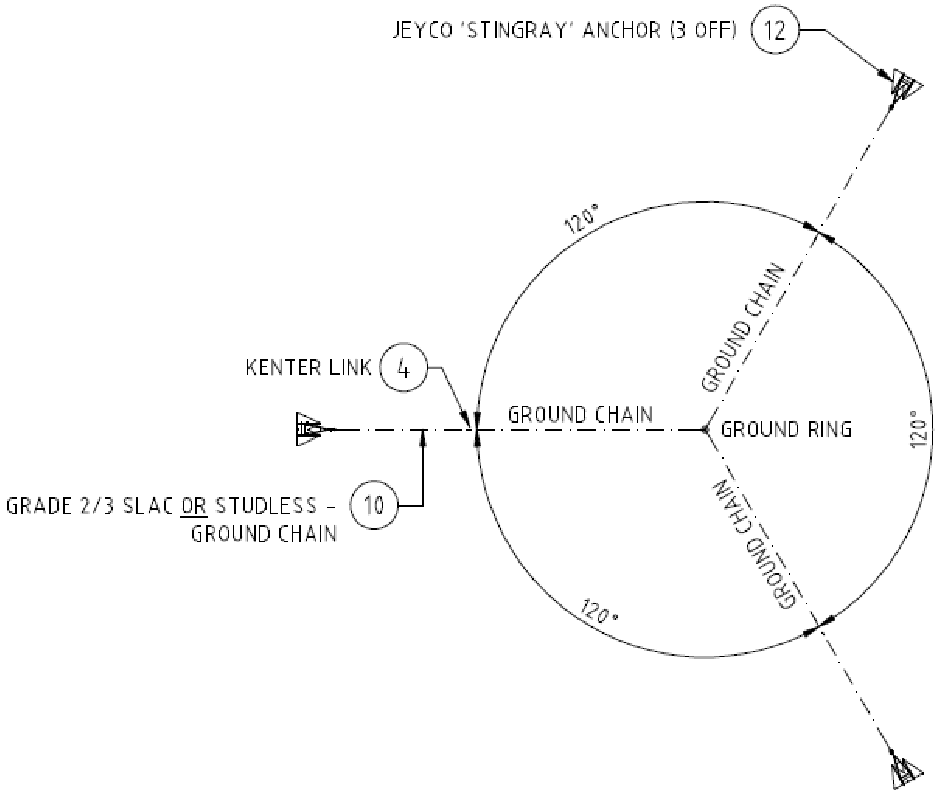

Figure 7: The Jeyco mooring system uses anchors to secure three chains to the seabed. This design can withstand dragging in storms and cyclones, which protects seagrass (Jeyco, 2013).

1.5.6 Cyclone Mooring

This design is similar to the Jeyco and EzyRider designs and consists of three chains secured to the seabed in a tripod formation; this is shown in Figure 8. The three chains are designed to prevent dragging on the seabed (Demers et al. 2013).

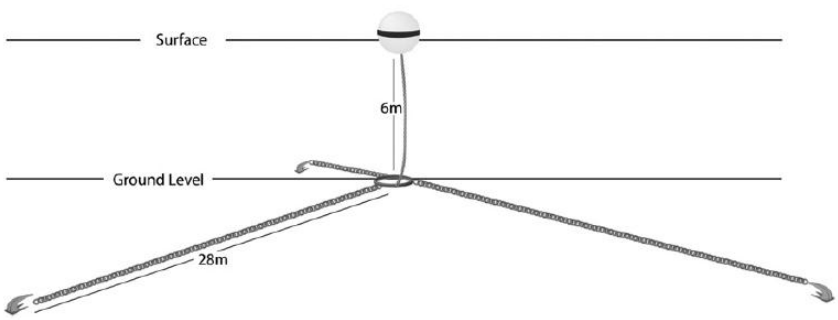

Figure 8: Shows the design of the 'environmentally-friendly' Cyclone Mooring (Demers et al. 2013).

1.6 Current Policy Issues

There is currently no clear legislation or policy position in NSW on the use of EFMs. Whilst the *Fisheries Management Act 1994* provides for the protection of seagrass, there is no legislative mechanism to make their use mandatory in or adjacent to seagrass areas as an alternative to traditional block and chain moorings. The cumulative impacts of traditional BCMs are becoming clearer to the scientific community and governments worldwide. The NSW and Queensland Governments have recently conducted several trials to determine the effectiveness of EFMs, and the feasibility of developing a policy position to support their adoption in seagrass areas.

To date there has been no comprehensive review of the overall success of EFMs in Australia. This project attempts to conduct such a review and to interview key stakeholders to inform the development of a NSW policy on EFMs as an alternative to traditional moorings.

The EFM trials to date have been carefully monitored in NSW and Queensland. Key issues identified through these trials have included the need to examine the effectiveness of EFMs over time, the installation cost, total costs including ongoing maintenance compared to traditional moorings, maintenance period, record of successful operation, ease of installation (NSW Waterways Authority, 2003). The trials in NSW have also indicated that environmental conditions may limit the success of EFMs and seagrass recovery in some locations.

1.7 Aims and Objectives

The aim of this report will be to evaluate the outcomes of recent "environmentally-friendly" mooring trials in Australia, and to determine whether they can be an effective alternative to traditional BCMs to improve seagrass protection and rehabilitation. The outcomes will be used to inform the development of a NSW policy position on EFMs. The objectives will include:

- Identifying the importance of Australia's seagrass
- Highlighting traditional BCMs as a significant threat to Australia's seagrass beds.
- Determining whether EFMs are an effective alternative to traditional BCMs to improve seagrass protection and rehabilitation.
- Reviewing potential EFM issues, including technical aspects (design, implementation and maintenance), environmental factors that may limit effectiveness, costs and any potential liability concerns.
- Interviewing key NSW stakeholders to determine their responses to the EFM trials, any concerns and what will need to occur in the future before EFMs can replace traditional moorings.

2 METHODS

2.1 Resources

Background information was obtained by searching the Southern Cross University databases for environmental science and the Department of Primary Industries science and research database. These were useful to obtain journal articles, books and reports related to seagrass and trials of EFMs in Australia.

2.2 Trials

The report will examine recent EFM trials in Australia that have been undertaken at the following locations:

- Jervis Bay Marine Park, NSW,
- Port Stephens, NSW,
- North Sydney Harbour, NSW,
- Pittwater, NSW,
- Moreton Bay, QLD,
- Rottnest Island, WA.

The major outcomes from each of these trials was investigated to identify whether EFMs were effective in protecting and restoring seagrass, and to assess any issues identified and documented during the trials. Trials which will be reviewed are shown in Figure 9.

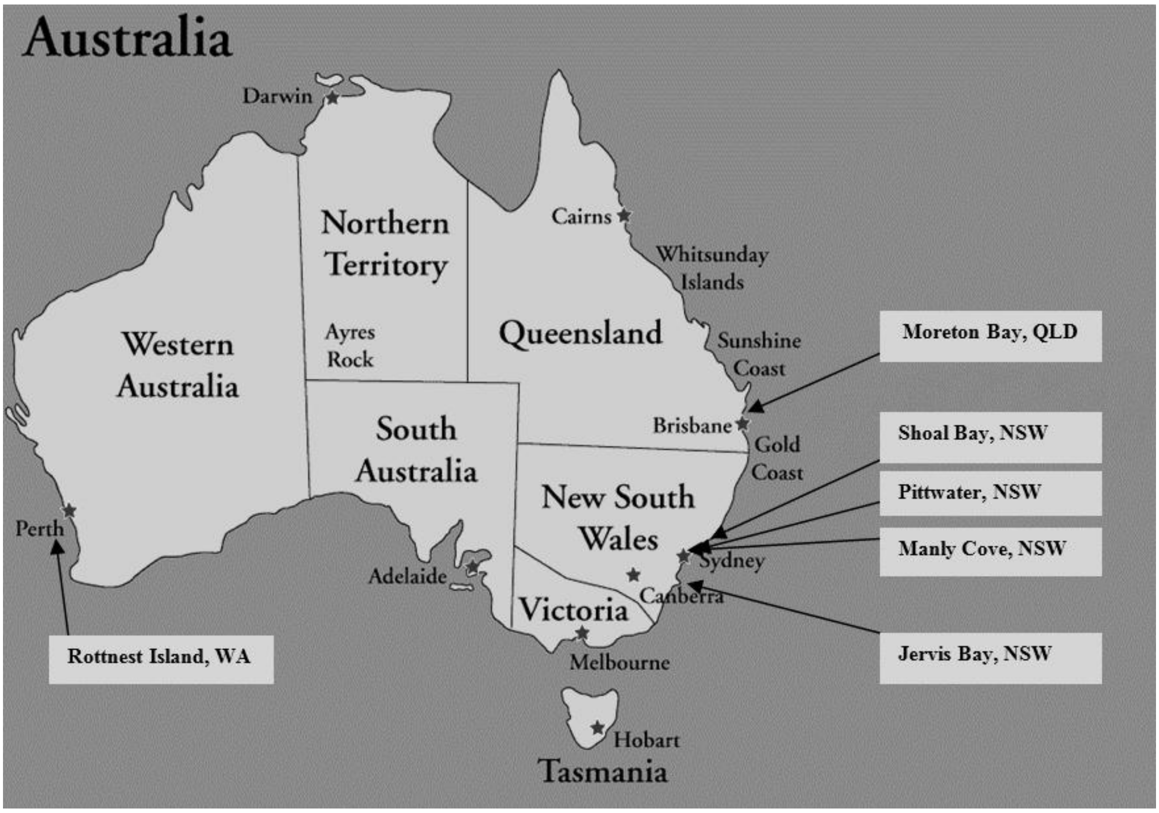

Figure 9: Recent trials of EFMs which have been conducted in Australia.

2.3 Technical Factors, Design and Maintenance

The reports from the trials were examined to determine what worked well and what didn't work well with each design and reasons why. Technical issues with each mooring design and trial were documented. This involved checking the annual maintenance results from each study, identifying areas of success, and noting component parts of EFMs that did not perform well. The supply of parts for EFMs was investigated to determine whether they are difficult to obtain compared with the ability of sourcing parts for traditional BCMs. Trial data relating to the effectiveness of EFMs in extreme weather events was analysed to determine how EFMs behaved, such as storms with strong wind and wave action to determine whether they cope as well or better than traditional BCMs.

2.4 Cost

The cost of installing and maintaining EFMs compared with traditional BCMs was documented where possible as this is likely to be a significant issue for boat owners if the government adopts a policy position supporting their use in seagrass areas.

2.5 Seagrass Recovery

Each trial was reviewed to identify whether EFMs contributed to the protection and recovery of seagrass. The effectiveness of each design was reviewed to determine which designs had the best results. For example, was the seagrass able to recover at every trial location? How did each of the NSW species of seagrass respond to the EFMs? Did some respond better than others? The regrowth of the endangered population of *Posidonia australis* in the trials was also examined.

2.6 Targeted Interviews with Key Stakeholders

A questionnaire was developed for key stakeholders, who are likely to be influential in the development and adoption of a policy position in NSW. Stakeholders who responded included:

- Office of Boating Safety and Maritime
- NSW Department of Primary Industries – Fisheries NSW
- NSW Department of Primary Industries – Port Stephens, Great Lakes Marine Park
- Office of Environment and Heritage, NSW Department of Premier and Cabinet
- Hunter-Central River Catchment Management Authority (CMA)
- University of Technology Sydney (UTS)

- Queensland Department of National Parks, Recreation, Sport and Racing
- On Water Marine Services pty ltd
- Seaflex Moorings Australia

The questions were developed from the analysis of the EFM trial reports from Australia and discussion with Fisheries NSW habitat protection managers. A copy the letter sent to the stakeholder participants and the stakeholder questionnaire are included in **Appendix 1 & 2**. The information recorded from the questionnaires will be used to identify potential issues that may need to be addressed and resolved before a policy position can be adopted on EFMs in NSW. Human ethics approval was granted prior to commencing the survey.

3 REVIEW OF RECENT EFM TRIALS

3.1 Manly Cove, NSW (2010-2012)

3.1.1 Summary of the Trial Design

- A total of 4 SFMs, 4 BCMs and 4 control locations were monitored (Gladstone, 2010a).
- SFMs were positioned where old BCMs had been removed, shown in Figure 10.
- SFMs and BCMs were located in Manly Cove East (Gladstone, 2010a).
- 3 controls were located at Manly Cove East and 1 at Manly Cove West (all had similar environmental conditions).
- The controls were used to represent natural variations in the characteristics (Gladstone 2010a)
- Final monitoring will take place in 2013 and the report is yet to be finalised (Gladstone, 2012).

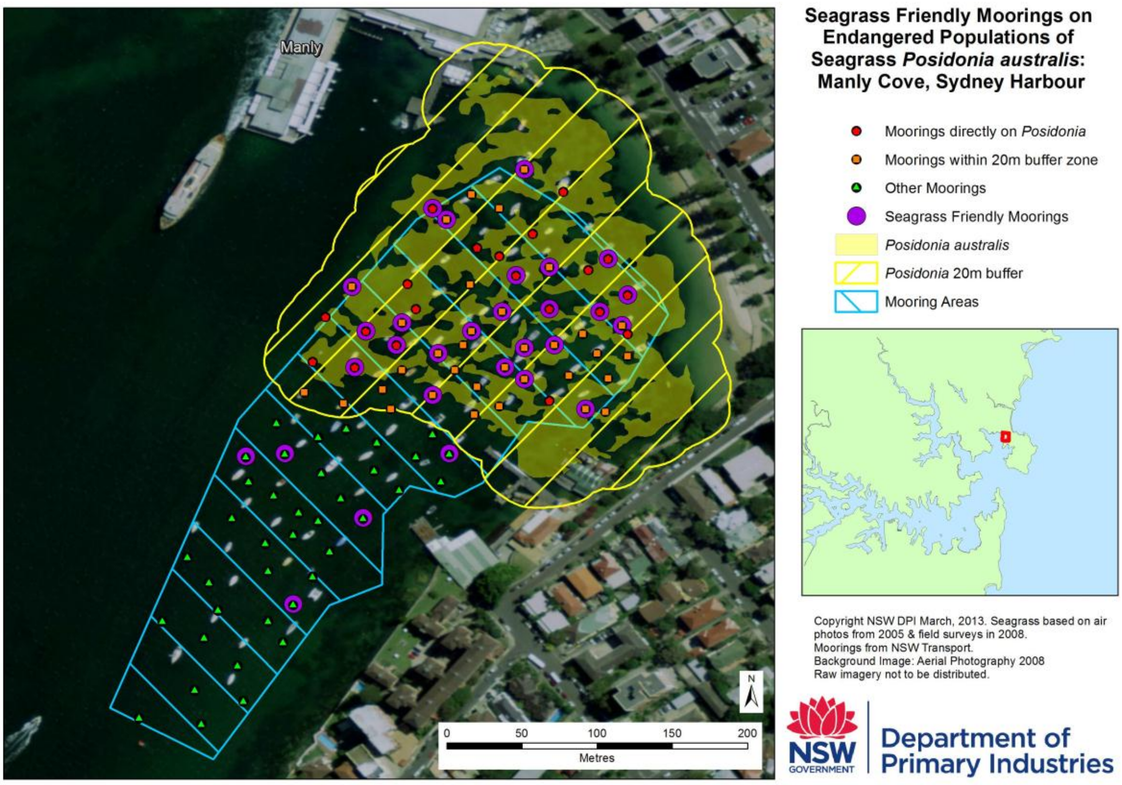

Figure 10: Shows moorings located within Manly Cove, NSW, and the diagram highlights those moorings which are located directly on top of an endangered population of *Posidonia australis* (NSW DPI, 2013).

3.1.2 Summary of the results from the trial

Mooring scours changed between 2010 and 2012 for both SFMs and BCMs; however a consistent decline did not occur (Gladstone, 2012). *Zostera capricorni* growth within the scours of the SFMs and BCMs did not differ significantly between 2010 and 2012. *Zostera capricorni* leaf length was significantly shorter within the SFM and BCM scours compared with the control sites (Gladstone, 2012). *Posidonia australis* was not found in the former scours around SFMs or the scours around BCMs in 2010 and 2011; however it was identified for the first time within the scour of 1 SFM and 1 BCM in 2012 (Gladstone, 2012). *Halophila spp.* was found at all scour locations and its cover did not differ between the SFMs and BCMs, or in the surrounding seagrass beds. The total percentage cover of seagrass within the scours of SFMs and BCMs was similar and both mooring types had less cover than the control sites (Gladstone, 2012). Habitat compositions of the seagrass beds around SFMs and BCMs did not differ, however they were both significantly different to the control sites. Cover of sand was similar in the scours of SFMs and BCMs; with both having more sand than the control sites (Gladstone, 2012). There were no technical issues with the SFMs in 2010 and 2011. One SFM was found to be malfunctioning in 2012 (the end of the arm was dragging in the sand). A second SFM was on the verge of malfunctioning in 2012 as well (Gladstone, 2012).

3.2 Jervis Bay, NSW (2012)

3.2.1 Summary of the Trial Design

- Seagrass density and cover surrounding each mooring type and in reference areas were studied (Demers et al. 2013). This included:
    - A reference area, a SFM and a BCM installed at two sites at Callala Bay, the location is shown in Figure 11;
    - A reference area and a cyclone mooring at three sites at Callala Bay;
    - A reference area and a BCM at two sites at Bindijine Beach (Demers et al. 2013).

- Reference areas for each site were located at least 10 m from existing moorings over similar depths and conditions to the adjacent mooring(s). This reduced the spatial variation in seagrass density and cover (Demers et al. 2013).

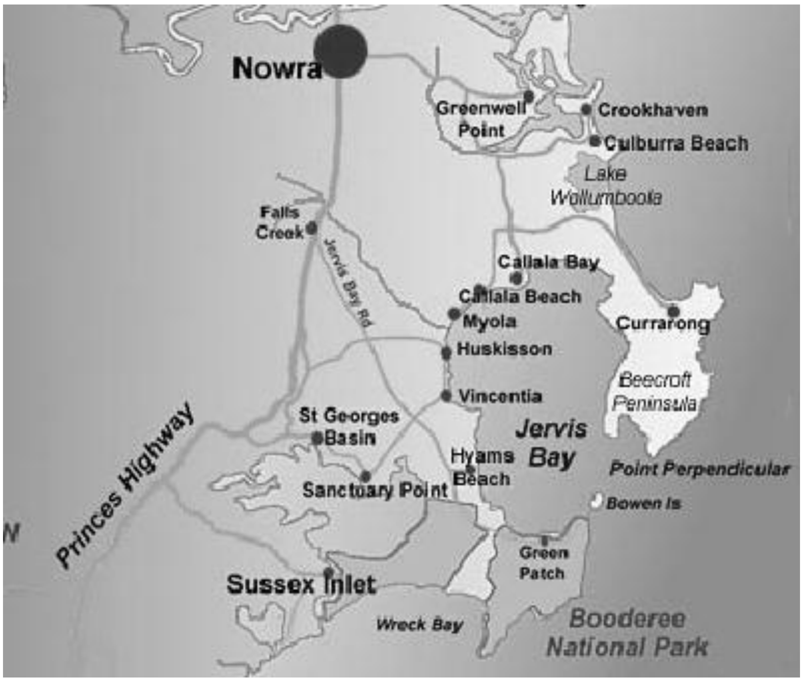

Figure 11: Shows the location of Jervis Bay, NSW, and the features around it (South Coast NSW, 2013).

3.2.2 Summary of the results from the trial

BCMs consistently lacked seagrass around them during the trial. At 9m from the mooring anchor, seagrass density and cover were similar to the reference area (Demers et al. 2013). Seagrass density and cover surrounding the SFM at Callala Bay and Bindijine Beach were very similar to the seagrass growth at the reference areas at these locations. Site 1 at Callala Bay had seagrass cover and density that were generally lower surrounding the SFM than in the reference area (Demers et al. 2013). *Posidonia* density and cover around the SFMs was very similar to that at the reference areas. The radius of the scoured areas for BCMs extended out up to 9m. A small circular scar was present around most of the SFMs at Bindijine Beach. This was approximately 10 cm in width (Demers et al. 2013). Contact between the coupling and the substratum had created this small disturbance. This was not observed at Callala Bay because the SFMs sat higher above the substratum (Demers et al. 2013). The seagrass was recovering around some of the SFMs. *H. ovalis* and *Zostera* spp., which are pioneer species, colonised areas that were previously damaged (Demers et al. 2013). Large areas were cleared of seagrass at all of the cyclone moorings. These areas were in the form of a “Y” shape, very similar to the layout of the mooring. Most of these “Y” shaped scars extended 18m from the centre of the mooring (Demers et al. 2013).

3.3 Shoal Bay, NSW (2008-2010)

3.3.1 Summary of the Trial Design

- This trial included an investigation and review of the condition of seagrass beds in December 2010 around five SFMs; shown in Figure 12. These were installed in Shoal Bay, Port Stephens, in 2008 (Gladstone, 2011).

- After inspection, all of the moorings appeared to be functioning properly (Gladstone, 2011).

- The scours in 2008 resulted from the former BCMs and could be clearly identified as bare sections of sand around each SFM. In 2010 the boundary of BCM scours could not be defined as a result of the growth of seagrass around SFMs (Gladstone, 2011).

Figure 12: The five SFMs located within Shoal Bay, NSW (Gladstone, 2011).

3.3.2 Summary of the results from the trial

Monitoring in 2010 showed that the seagrass from 2009 was still present; however the images showed new seagrass (mostly *Zostera capricorni*) in the former mooring scours around three SFMs (Gladstone, 2011). In 2010 the boundary of the mooring scour was difficult to define because the seagrass had grown significantly (Gladstone, 2011). The total seagrass cover and cover of sand were not different between former mooring scours and surrounding seagrass beds in four out of five moorings (Gladstone, 2011). There was a significant "mooring x position" interaction for mean length of *Z. capricorni* leaves, as mean leaf length differed at two moorings, and did not differ at three moorings (Gladstone, 2011).

A significant "mooring x position" interaction occurred with *Posidonia australis*, as average leaf length in the former mooring scour was less than the surrounding bed at one of the moorings, but at another mooring there was no difference (Gladstone, 2011). Only two moorings were tested because of the limited amount of *Posidonia australis*. The mean percentage cover of *Z. capricorni* did not differ between the former scours and the surrounding seagrass bed. Cover of *Halophila* spp. was not different between the former mooring scours and the nearby seagrass beds. The moorings were inspected and all appeared to be functioning properly (Gladstone, 2011).

3.4 Pittwater, NSW (2009-2011)

3.4.1 Summary of the Trial Design

Summary of the trial design:

- The effectiveness of SFMs was assessed by monitoring seagrass growth annually for three years (2009-11). A total of six SFMs and six BCM moorings were monitored. The report for 2011 was not available (Gladstone, 2010b).

- Monitoring took place at Mackerel Beach (six moorings), Palm Beach (four moorings), and Sandy Beach (two moorings); shown in Figure 13 (Gladstone, 2010b).

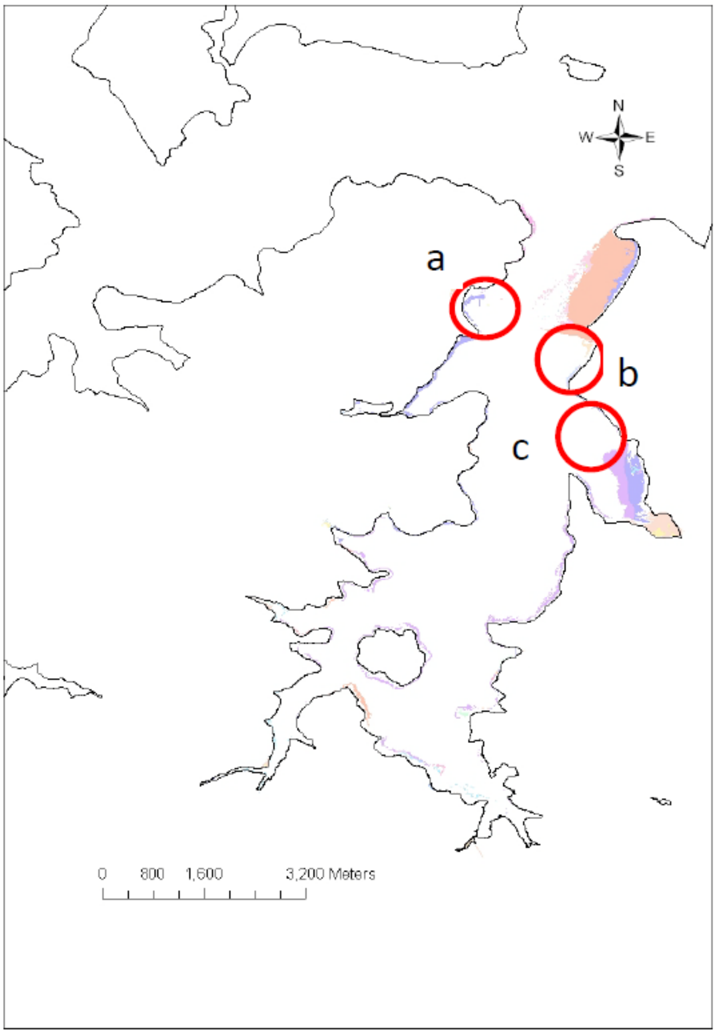

Figure 13: The locations where SFMs and BCMs were monitored within the Pittwater Estuary, NSW. Site A is at Mackerel Beach, Site B is at Palm Beach and Site C is at Sandy Beach (Gladstone, 2010b).

3.4.2 Summary of the results from the trial

Maps showed that the size of mooring scours around SFMs decreased; this trend did not occur around BCMs (Gladstone, 2010b). The cover of *Zostera capricorni* increased between 2009 (~1 percent cover) and 2010 (~2 percent cover) (Gladstone, 2010b). No significant changes occurred with BCM scours. In 2010 there was a four-fold increase in the mean length of *Zostera capricorni* leaves around SFMs (Gladstone, 2010b). Leaf length in the mooring scours of BCMs remained similar to 2009. The occurrence of *P. australis* did not differ significantly between SFMs and BCMs in 2010. Between 2009 and 2010 the percentage occurrence of *Halophila* spp. around SFMs increased from 56.25% to 70.85%, and changed from 56.25% to 46.9% around BCMs (Gladstone, 2010b). The mean leaf length of *Halophila* spp. inside mooring scours appeared to be less than mean leaf length outside scours. The cover of sand was significantly greater in the mooring scours of SFMs and BCMs than the surrounding seagrass beds (Gladstone, 2010b). All SFMs appeared to be functioning correctly, with the exception that part of the shackle linking one SFM to the float rope was dragging in the sand (Gladstone, 2010b).

3.5 Moreton Bay, QLD (2010-2011)

3.5.1 Summary of the Trial Design

- Three EFM designs were trialled at four different locations in Moreton Bay (total of 12); these were the Seagrass Friendly Mooring System, EzyRider Mooring and Seaflex (DEEDI, 2011).

- The trial went for 18 months and all the moorings were serviced two times.

- Questionnaires were developed to identify project and mooring issues. These were completed by the trial participants after the first EFM service, and interviews were also conducted with the trial participants, mooring designers and contractors after the second EFM service (DEEDI, 2011).

- The trial will monitor the effectiveness of the Seagrass Friendly Moorings to hold boats in the conditions of Moreton Bay, the number and variety of benthic animals (bottom dwelling animals), EFM impacts on nearby benthos, the EFM causing the least damage to seagrass meadows, and the differences between areas with moorings to nearby areas without moorings (DEEDI, 2011).

3.5.2 Summary of the results from the trial

There was installation issues associated with each mooring. At Tangalooma, the installer of the SFM system did not have a long enough drill rig on the day to reach the sea bed of the nominated location (approximately 10 m deep), therefore the SFM was put at 5m (DEEDI, 2011). The EzyRider mooring at Point Halloran was shifted because it had too large a swing area. A ‘locking bar’ was not supplied with the EzyRider, and also the supplied shackles were not the recommended ‘green pin safety shackles’ (DEEDI, 2011). The offset pin anchor system used on EzyRider moorings was not suitable for the trial locations with silty sediments (Point Halloran and Dalpura Bay) (DEEDI, 2011). Concrete blocks were used. The Seaflex mooring at Point Halloran was shifted as it had too large a swing area. An anchor system does not come with Seaflex moorings (DEEDI, 2011).

Minor corrosion was evident in July 2011 on the steel shackles of SFMs; these were replaced with stainless steel shackles (DEEDI, 2011). Electrolysis was identified between galvanised shackles and their stainless steel mousing wire (DEEDI, 2011). A nyloc lock nutted and bolted version was used as a replacement in July 2011 (precaution). A hawser rope was worn through on a bow roller after an owner had not set up the mooring line with the protective sheave on the bow roller (DEEDI, 2011). The swivel eye of the EzyRider mooring at One Mile was found to be seized in October 2010. The long chain was observed in October 2010 to pull the buoy rubbers down at low tide, causing the chain to drag (DEEDI, 2011). A screw was missing from the plastic grommet at the bottom of the buoy shaft of the Seaflex mooring at One Mile in October 2010 (DEEDI, 2011). The mooring rope twisted around the hawser in October 2010, due to the longer rope length required in deeper water, and the rope dropping on low tide with little boat activity (DEEDI, 2011). The mooring line at One Mile was observed to occasionally tangle with the subsurface shock absorber in 2010. The mooring at Dalpura Bay broke away in June 2011 as a shackle pin had worked loose despite shackle mousing (DEEDI, 2011). It is uncertain if use of 'yellow pin' rather than 'green pin' shackles may have contributed to the EzyRider shackle failures (DEEDI, 2011).

3.6 Rottnest Island

3.6.1 Summary of the results from the trial

The extent of seagrass cover lost to moorings was monitored at Rottnest Island in Western Australia, which is located 18km off the coast from Perth (Hastings et al., 1995); shown in Figure 14. Approximately 18% of seagrass cover has been lost at Rottnest Island as a result of boat moorings (Hastings et al., 1995). The fragmentation created by the boat moorings at Rottnest Island caused the eroding edge to increase by 230% and numerous 'blowouts' were observed between 1981 and 1992 (Hastings et al., 1995). In 1986 the Rottnest Island Authority (RIA) started to install cyclone moorings rather than SFMs. These consisted of a three leg chain system similar to the EzyRider and Jeyco Mooring designs (Hastings et al., 1995). Traditional block & chain moorings had an average scour size of $39m^2$. The cyclone moorings reduced this to as low as $3m^2$, however the new moorings often created three scours, approximately 10m in diameter, where the lower anchor chains were scouring the seagrass meadows (Hastings et al., 1995).

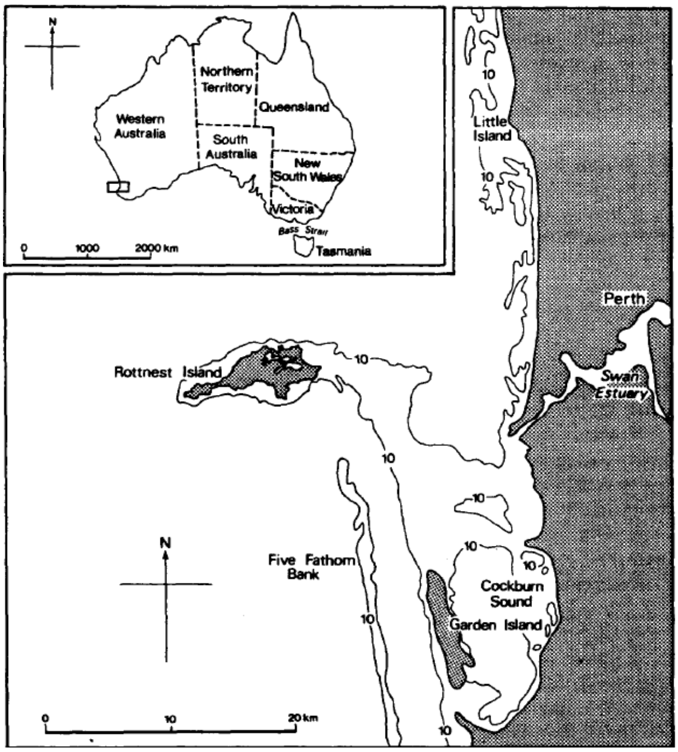

Figure 14: The location and features of Rottnest island, WA; show the position of Rottnest Island in relation to mainland Australia (Hastings et al., 1995).

4 DISCUSSION OF TRIALS

4.1 Seagrass Recovery

The trials found that seagrass recovery was generally positive around Seagrass Friendly Moorings, particularly at Pittwater, Shoal Bay and Jervis Bay in NSW, and Moreton Bay in QLD (Gladstone 2010b; Gladstone, 2011; Gladstone 2012; Demers et al., 2013). Seagrass growth and recovery was often similar to the control sites which represented natural undisturbed seagrass meadows. Traditional block and chain moorings (BCMs) did not generally show an improvement in seagrass density and cover compared with the SFMs (Gladstone 2010b; Gladstone, 2011; Demers et al., 2013). SFMs did not perform well in the trials at Manly Cove where there was no sign of improvement (Gladstone, 2012); however this may be related to the seagrass, physical characteristics of the landscape and other anthropogenic pressures (Gladstone, 2012). Monitoring results for 2013 have not yet been published. Environmentally-friendly cyclone moorings were trialled alongside BCMs and SFMs at Jervis Bay in NSW. They created scours approximately double the size of the scours located around BCMs, and therefore performed worse than both of these moorings (Demers et al., 2013). Seagrass cover and density was always lower around cyclone moorings. Large scours, often three per mooring, also formed around cyclone moorings which were installed at Rottnest Island (Hastings et al., 1995). The design of cyclone moorings will require significant improvement before it can be considered environmentally friendly for use in seagrass, particularly to prevent the lower anchor chains scouring the seabed (Hastings et al., 1995).

The Seagrass Friendly Mooring, EzyRider Mooring and Seaflex Mooring were all trialled at Moreton Bay in QLD (DEEDI, 2011). Detailed information on seagrass recovery for each mooring trialled is limited, however the report by SEQ Catchments (2013) states that the Seagrass Friendly Mooring design performed the best in the environmental conditions of Moreton Bay. There was a significant recovery in seagrass species around all three of the mooring designs (SEQ Catchments, 2013), and an ecological study conducted by the University of Queensland (UQ) identified that benthic assemblages were less “patchy” following the installation of EFMs (DEEDI, 2011). The findings of the UQ study are relevant outside of Moreton Bay because the four sites had a variety of environmental characteristics and benthic communities similar to other coastal sites (DEEDI, 2011).

4.2 Technical Issues

The SFMs performed well in all trials with no major technical problems occurring in any of the trials. Minor repairs were required, such as replacing corroded and loose shackles, the prevention of electrolysis, the replacement of a worn through hawser rope, untangling mooring lines from the subsurface shock absorber, and fixing the arm on one mooring which was dragging (Gladstone 2010a; Gladstone, 2010b; DEEDI, 2011; Gladstone, 2011; Gladstone 2012; Demers et al., 2013). No failures of SFMs were recorded. Installation issues, such as the inadequate drill rig used at Moreton Bay, will be prevented in future installations with the creation of a quality management system. This will involve training installers and maintainers and ensuring the correct equipment is used (DEEDI, 2011). No moorings were pulled out of once they had been installed and screwed into the seabed, which proves that SFMs are able to cope with most environmental conditions (DEEDI, 2011). The screw anchor demonstrated that it could exceed the 50m/s wind speeds and wave heights of 2m which are experienced in Moreton Bay (DEEDI, 2011). There was no significant supply issues associated with SFMs. Some of the mooring owners who participated in the Moreton Bay trials recommended that parts could be accessed easier for EFMs if local industries were established; this has the potential to create new jobs and prevent delays in the supply of spare parts (DEEDI, 2011). Boat owners were able to service their own SFM moorings or pay approximately $300/year to get a trained contractor to complete the annual maintenance (DEEDI, 2011).

EzyRider Moorings were not used in the NSW trials; however they were installed and monitored during the Moreton Bay trials between 2010-2011. Four EzyRider Moorings were used and two of these failed as a result of the shackle pin becoming loose (DEEDI, 2011). Manufacturers and contractors of the EzyRider Mooring were made aware of this problem and have since been investigating the cause. It is possible that the failures occurred because the moorings were not supplied with the recommended ‘green pin safety shackles’ (DEEDI, 2011). The ‘yellow pin’ shackles may not have been suitable (DEEDI, 2011); however minor wearing of shackles is relatively common for most mooring types (Bowman, 2008). Designers and manufacturers of the EzyRider Mooring may need to consider reducing the vessel swing area, to a smaller area more suited to congested waterways. Supplying incorrect parts or missing parts can be prevented by recording each section of the mooring as it is packed.

A technical issue of concern with Seaflex Moorings is that they do not come with an anchor system (DEEDI, 2011). This has the potential to inhibit their ability to prevent scouring of seagrass meadows. The mooring licensee has to find an anchor for this mooring system, which may consist of a cement block or anchor manufactured by a different company, which is what occurred during the Moreton Bay trial. Although the anchors chosen for the Seaflex system in Moreton Bay were effective (DEEDI, 2011), an inexperienced boat owner may select an inadequate anchor. Another design consideration for Seaflex manufacturers is the large swing area of this mooring system which can cause vessels to become too close to each other, particularly in congested waterways with high numbers of private moorings (DEEDI, 2011), which was also experienced with the EzyRider design. One Seaflex mooring out of the four installed at Moreton Bay failed as a result of a plastic sleeve becoming disconnected from the shaft, which then caused the rope to break because it was rubbing against the shaft (DEEDI, 2011). As a result of this discovery Seaflex now installs 4 screws around the grommet to prevent the sleeve becoming loose (DEEDI, 2011). At the time of the Moreton Bay trials there were no installation instructions included, however the Seaflex has since developed an inspection instruction manual in response to the trial (DEEDI, 2011).

5 QUESTIONNAIRE RESPONSES

The key information gathered from the stakeholder was categorised in Table 1.

Table 1: Key Responses from Stakeholders.

Key Responses from Stakeholders
Stakeholders who contributed to the following key points include: • **Office of Boating Safety and Maritime** • **NSW Department of Primary Industries – Fisheries NSW** • **NSW Department of Primary Industries – Port Stephens, Great Lakes Marine Park** • **Office of Environment and Heritage, NSW Department of Premier and Cabinet** • **Hunter-Central River Catchment Management Authority (CMA)** • **University of Technology Sydney (UTS)** • **Queensland Department of National Parks, Recreation, Sport and Racing** • **On Water Marine Services pty ltd** • **Seaflex Moorings Australia**
5.1 Costs • The lack of awareness about damage caused by BCMs and boater confidence, such as concerns about mooring design and vessel protection, are issues that are having a greater impact on the uptake of EFMs. • Agree that costs are a limiting factor. Lower cost through greater uptake, improved technologies and increased numbers of trained contractors. Increased awareness/demand for the EFMs will drive prices down. • Subsidies/ Initiatives: o Could incorporate the value of seagrass lost (approximately $102 per sq. metre for *Posidonia*). Over 10 or 20 years (longevity of most moorings) this would add approximately $500 to $1000 to the annual cost of a conventional mooring.

- Include first 5 years maintenance differential for EFMs.
    - Culture change necessary through education programs, e.g. presentations at boating clubs or mailing out EFM trial results to boat owners.
    - A policy change requiring EFMs to be used in seagrass areas.
    - Rebates/ one off full or partial payments for EFMs and their installation would be a big incentive for boat owners.
    - Introducing an environmental performance standard for moorings would put EFMs and other moorings on a level playing field, increased innovation and completion would lower costs.
    - No-interest loans to purchase EFMs, and/or an environmental levy on block and chain moorings.
    - Deployment of a large number of EFMs at one time and also performing maintenance at the same time will lower installation and maintenance costs.
    - Reduce or remove approval requirements/fees.

- Life cycle cost of EFMs must be communicated effectively if it is released. Some suppliers already provide life cycle costs.

5.2 Technical Issues – Installation and Maintenance

Maintenance:

- Most stakeholders had no concerns about EFM suppliers installing and maintaining moorings as long as they are qualified and ensure their products are safe.
- Maintenance is a key area of concern, e.g. trials in Port Stephens.
- Development of a mandatory inspection form to be submitted each year, regardless of mooring type.
- Maintenance should be at least annually.
- More sub-contractors need training in servicing the EFM designs.

Issues with Installation/ Design:

- Limited success in some locations (e.g. Moreton Bay and Manly Cove East).

- Designs need to be tested in varying wind and wave energy scenarios to determine the areas they are suitable.

- Marine growth has the potential to weigh the arm of the SFM down, therefore regular maintenance is required.

Maintenance of EFMs by Boat Owners:

- Some designs can be serviced by mooring owners. SFM owners can remove the shock absorber themselves and reattach serviced one.

- A "do-it-yourself" maintenance guide can be developed to keep costs down. Components and check sheet now available for SFM owners so that they can do their own servicing.

- No- mooring owners shouldn't maintain their own EFMs because the warranty may be voided if inappropriate servicing or parts are used. This could damage the public's perception of EFMs and it is a potential safety/insurance risk.

5.3 Supply of EFMs and Parts

- A sole supplier/ single design/ single operator doing maintenance can cause potential issues.

- Difficulty of sourcing parts will depend on the type of EFM used.

- Increased numbers of EFMs will increase supply and lower costs.

5.4 Support for the use of EFMs as an alternative to BCMs

EFMs as an alternative to BCMs:

- Agree that EFMs are a better alternative to BCMs because they help to prevent scoured rings in seagrass meadows.

- Designs that failed during the trials need further work and assessment before they are considered as alternatives.

- Use should be mandated in environmentally sensitive areas.

Limitations of EFMs:

- Depth of water in relation to tide range.

- Changes in the weight of the apparatus with fouling and part(s) of the apparatus contacting the seabed.
- The myth that EFMs can't hold the same load could be dispelled through proper testing.
- Sediment depth for screwing required by SFMs.
- Boat size.
- Mix of EFMs and BCMs in the same area is not compatible due to different swing sizes.
- Rock seabed.

<u>Customer Satisfaction:</u>

- Customer satisfaction improved through better maintenance, servicing, responsiveness and improved designs.

5.5 Design

<u>Standard/ accreditation process for installation and maintenance of EFMs:</u>

- If a standard/accreditation process for EFMs is developed it should be applied to all mooring types.
- Would help to maintain warranty, provide quality assurance and set operational requirements. However, installation and maintenance will vary for different designs and locations.
- Is required to ensure environmental standards and OHS standards.
- A standard/accreditation process is required for customer confidence. Also to highlight specific requirements for different types of vessels/hulls and vessel weights.
- A standard/accreditation process for SFMs is being currently developed to ensure the same level of expertise is always applied, and short training videos are being developed for owners.
- A standard/accreditation process shouldn't be developed because the difference in EFM systems is too big to put under one umbrella.

<u>Designs which have worked well and which designs have not:</u>

- Des Maslen's SFMs appear to work the best in most conditions and have failed the least in comparison with other EFMs trialled.

- Cyclone moorings have been proven to cause extensive damage.

- It is dependent on the environment, location and boat type. All require appropriate maintenance.

5.6 Recovery of Seagrass

- Agree that EFMs contribute to seagrass recovery, especially *Halophila* and *Zostera*. Recovery of *Posidonia* is likely to take much longer. Heavy wave action, ongoing seabed erosion and sediment instability may inhibit effectiveness of EFMs.

- Limited recovery of seagrass during the trials in Manly Cove East.

- Yes agree that EFMs contribute to the recovery and protection of seagrass, however it will depend on the type of seagrass, the availability of seed, proximity to non-impacted seagrass for roots to expand across the old impacted area and of course water clarity.

- In areas where seagrass might not have regrown, benthic creatures are re-appearing.

5.7 Industry Development

Expansion of the EFM Industry

- Reduce 'red tape' for new EFM suppliers and educate boat owners.

- Agree to industry development – for example offering a rebating system for those EFMs that have proved effective during trials; this may encourage additional suppliers. The government should encourage new designs.

- Creating franchises, e.g. Des Maslen's SFM business.

- Suppliers should have to tender for the work in each location/region.

- Should expand the EFM industry to prevent it becoming monopolised.

- A sunset clause would provide incentive for new designs.

- Could be achieved by innovation grants and awards, and small business support etc. However the government shouldn't promote specific suppliers. Potential market of 25,000 mooring which need replacing in Australia.

- The current monopoly is only due to the success of SFMs

5.8 Legislation and Policy on EFMs

Policy Position on EFMs

- Agree that the NSW Government should have a policy position on EFMs, but this needs to be developed in consultation with stakeholders.

- Should provide an outline of why seagrasses are affected by moorings, why they need protection, the outcomes of the trials and lessons learned so far from Australian trials, issues that mooring owners need to consider when selecting a suitable EFM arising from the trials, priority moorings to consider conversion to EFMs (e.g. those affecting seagrass and in particular endangered *Posidonia australis* populations), how they can convert over to EFMs and any potential incentives available.

- Disagree that the NSW Government should have a policy position on EFMs; shouldn't insist on the use of EFMs while there is limited choice of supplier/design/installer.

Legislative Change

- Policy change should be adequate. *Fisheries Management Act* protects seagrass well already.
- Agree that there is a need for legislative change to adopt EFMs, to define designated mooring areas (EFM only areas) and facilitate the approval and deployment of EFMs in these areas.
- Agree to legislative change – removal of the permit from RMS from the *Fisheries Management Act 1994* for BCMs.

'Red Tape'

- 'Red tape' not the issue, it is a matter of willingness to introduce changes.
- Little 'red tape' at present.

5.9 Future Improvements to EFM Trials

Limiting Factors

- Some of the trials did not have a full set of 'control' and/or 'impact' moorings and sites, and before and after measurements. Therefore it was difficult to compare the EFM trial results.

- Limited supplier availability of the most effective EFM design.

- Limiting factors in recent trials - the Port Stephens project didn't allow for monitoring of controls, also Roads & Maritime Services (RMS) instructed mooring operators to put new public courtesy SFMs in wrong spot so baseline monitoring wasted.

- Initially there was confusion how to operate the SFM system, however demonstration days/ refinement of the design is improving this.
- Position of EFMs e.g. SFMs in Manly Cove.
- On Water Marine Services is sending letters to trial participants letting them know about the mooring performance.

Improving Communication

- Working with boating stakeholders to develop a communications strategy outlining the outcomes of the trials and lessons learned.
- Current survey of mooring holder participants in trials being undertaken to inform how this could be done.
- For example by presentations at meetings and boat shows.

Future Trials

- Load testing on EFMs.
- More moorings = increased sample size.
- Trials of traditional moorings are required.
- Continuing to examine the effectiveness of different EFM designs in differing environmental conditions within the same estuary. For example wind and wave conditions, light conditions and mooring usage rates.
- Sufficient trials- Some EFMs have been in use for more than 25 years, lots of information available.

6 DISCUSSION AND RECOMMENDATIONS OF THE STAKEHOLDER RESPONSES

6.1 Costs

Most stakeholders agree that the higher cost of EFMs is a limiting factor in their uptake, however there are also several other important factors which have contributed to the slow uptake. These include a lack of awareness from mooring owners about the environmental damage caused by traditional moorings, confidence in design and vessel protection. Higher cost for EFMs can be reduced by increasing EFM competition, improving designs, improving awareness, incorporating the value of seagrass lost into the prices for traditional moorings, and introducing a state wide policy which will strengthen the market and lower costs. EFMs are more expensive because they have to go through a much more rigorous engineering, testing and proving process, therefore BCMs should also have to go through this process. The NSW Government should also consider introducing incentives to encourage mooring owners to make the switch, such as a one off full or partial payment/ rebate which includes installation. Awareness can be improved through education, such as presentations at boating clubs, releasing trial results, creating pamphlets or creating a dedicated EFM website. If life cycle costs for EFMs are released they must be communicated in an effective manner, which does not cause uptake to fall.

6.2 Technical Issues – Installation and Maintenance

The stakeholders responses indicate that maintenance should be conducted at least annually and this should occur for all moorings regardless of the type. The stakeholders highlight that technical problems which arise are generally cause by a lack of maintenance. EFM designs which contain fewer wearing parts could also be developed, such as the Seaflex design, which may require less servicing; however they would still need to be monitored annually. A mandatory inspection form should be developed and submitted at least annually. The stakeholders generally had no issue with EFM suppliers installing and maintaining EFMs however they need to be qualified. There is a need for more sub-contractors and suppliers which will prevent a potential bottleneck and underservicing. A “do-it-yourself” maintenance guide could also be developed for mooring owners; however EFM designs would have to be simplified. Technical issues which need to be overcome include sand depth limitations and rocky seabeds, swing areas, vessel sizes and marine growth weighing the mooring arm down on SFMs. Future trials could test EFMs in new wind and wave scenarios.

6.3 Supply of EFMs and Parts

The main issues raised by the stakeholders in relation to the supply of EFMs and parts was that there is a need to increase the numbers of trained contractors and prevent the creation of a monopoly on supply. The stakeholders pointed out that increasing EFM supply and uptake will result in an increase in the number of parts manufactured, and this will also support struggling local manufacturers. If moorings are manufactured and constructed in Australia it will create new jobs which are lost to overseas countries if products are imported. For example the SFM produced by On Water Marine Services pty ltd, is expanding and has a new distributer being set up in Queensland, which will create jobs and improve supply.

6.4 Support for the use of EFMs as an alternative to Block & Chain Moorings

All stakeholders agree that EFMs are a much better alternative to traditional block and chain moorings which scour and fragment seagrass meadows. However, it is recommended that only those EFMs which have been proven to be effective in protecting seagrass and promoting recovery should be used as alternatives at this stage. Most stakeholders agree that a moratorium on the use of BCMs should occur; however it is recommended that prices be closer to parity first, the choice of supplier/installer should be allowed, and there should be a period of grace for boat owners with BCMs to make the switch. It should have a suitable system, such as the designated EFM areas used in south-east Queensland. The NSW Government could also consider including the economic cost in prices of existing BCMs, or incentives, such as discounts on boat registration if an EFM is used. Boat owners are much more likely to purchase EFMs if key stakeholders endorse EFMs and lead by example, such as replacing all public moorings with EFMs. Customer service can be improved if there is regular communication, design improvements, better maintenance and responsiveness.

6.5 Design

Stakeholder responses indicate that there should be a standard/ accreditation process. This should be applied to all moorings, regardless of the type, to ensure construction, installation and environmental standards are met. However, installation and maintenance will vary depending on the design and location, so these factors should be taken into account when developing mooring standards. Most stakeholders thought the SFM design was the most suitable mooring due to the positive results it has produced during the trials, for example in Qld and Jervis Bay; however regular maintenance is recommended. Cyclone moorings produced extensive damage, and shouldn't be used without further improvements.

6.6 Recovery of Seagrass

All stakeholders believed that EFMs were contributing to the recovery and protection of seagrass. Seagrass recovery around EFMs may be affected by the type of seagrass, the availability of seed, and proximity to non-impacted seagrass. It was noted that EFMs are particularly effective for the recovery of *Halophila* and *Zostera*, which are faster colonising species, whilst the recovery of Posidonia is likely to take much longer. The NSW Government should remove all BCMs within vulnerable seagrass meadows, such as *Posidonia*, as a matter of urgency.

6.7 Industry Development

The majority of stakeholders agreed that the EFM industry needs to be developed further in order for it not to become monopolised. Innovation grants, awards and support for small businesses are potential methods that the NSW Government could use to develop new EFM designs and manufacturers. The allocation, installation and lease of moorings, should be managed by the NSW Government in environmentally sensitive areas, and EFMs should be mandatory.

6.8 Legislation and Policy on EFMs

Almost all the stakeholders believed that the NSW Government should have a policy position on the use of EFMs; however there is currently a limited choice of suppliers, designs and installers. During the development of a policy on EFMs it will be vital to consult regularly with important stakeholders, and boat owners. It is recommended that a future policy on EFMs include priorities, such as vulnerable seagrass and locations, incentives, sunset clauses, outline why seagrass is impacted by moorings, overview of Australian trial results, issues that mooring owners should consider when choosing a EFM, and outline what is considered an EFM. There was a mixed response from stakeholders regarding whether or not legislative change is needed. A legislative change could include the removal of the permit for BCMs in the Fisheries Management Act 1994, which is issued by RMS. Also a legislative change would help to define designated mooring areas, which would only contain EFMs and assist in the approval and deployment of EFMs to these areas. However, it was also highlighted that the Fisheries Management Act 1994 protects seagrass well already, so there may only be an immediate need for a policy change. The NSW Government will have to take into consideration both options. There was also a mixed response to whether or not red tape should be reduced, however it was pointed out that it is more of a question about willingness to make changes.

6.9 Future Improvements to EFM Trials

A number of limiting factors were identified by the stakeholders from the recent EFM trials. Some of the trials did not have a full set of ‘control’ and/ or ‘impact’ moorings, and measurements from before and after. During the recent EFM trials at Port Stephens RMS instructed mooring owners to position courtesy SFMs in the wrong spot, which prevented baseline monitoring. The position of EFMs was also a limiting factor, e.g. Manly Cove trial. There can be confusion for mooring owners how to use an EFM. It is recommended that future trials be conducted to test whether EFMs can hold the same amount of weight as traditional moorings (which is often believed by boat owners), future trials should include a greater sampling size of EFMs and BCMs, and in a range of wind, wave and light conditions. Improved communication is essential, such as a partnership developed with boating stakeholders, which includes a communications strategy.

REFERENCES

Alkira Marine Services. (2013) *What parts may need to be replaced on my mooring?* Retrieved 15/05/2013, from http://www.alkiramarineservices.com.au/FAQRetrieve.aspx?ID=36488&Q=

Bell, S.S., Brooks, R.A., Robbins, D., Fonseca, M.S., & Hall, M.O. (2001). Faunal response to fragmentation in seagrass habitats: implications for seagrass conservation. *Biological Conservation*, 100, 115-123.

BoatMoorings.com (2013) Our Exclusive Eco Mooring. Retrieved 22/05/2013, from http://www.boatmoorings.com/

Bostrom, C., Jackson, E.L., & Simenstad, C.A. (2006). Seagrass landscapes and their effects on associated fauna: A review. *Estuar Coast Shelf Sci*, 68, 383-403.

Bowline marine. (2013) New Moorings. Retrieved 21/05/2013, from http://www.bowlinemarine.com.au/Moorings/NewMoorings.aspx

Bowman, L. (2008). *Seagrass friendly boat moorings: Feasibility assessment. Final report to the NSW Department of Primary Industries – Fisheries Conservation & Aquaculture*. Port Stephens, NSW.

Carlo, G.D., & McKenzie, L. (2011). *Seagrass Syllabus – A training manual for resource managers*. USA: Conservation International.

Carruthers, T.J., Dennison, W.C., Longstaff, B.J., Waycott, M., Abal, E.G., McKenzie, L.J., & Lee Long, W.J. (2002). Seagrass Habitats of Northeast Australia: Models of Key Processes and Controls. *Bulletin of Marine Science*, 71, 1153-1169.

Demers, M.A., Davis, A.R. & Knott, N.A. (2013). A comparison of the impact of 'Seagrass-friendly' boat mooring systems on Posidonia australis. *Marine Environmental Research*, 83, 54-62.

Department of Employment, Economic Development and Innovation (DEEDI). (2011). *Environmentally-friendly moorings trials in Moreton Bay. Final report to SEQ Catchments*. Brisbane, Australia.

Environment Protection Agency. (1998). *Changes in Seagrass Coverage and Links to Water Quality off the Adelaide Metropolitan Coastline. Final report to Department for Environment, Heritage and Aboriginal Affairs*. Adelaide.

EzyRider mooring. (2013) EzyRider mooring – How it works. Retrieved 22/05/2013, from http://www.ezyridermooring.com/index.html?art=1

Fairfull, S. (2013). *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management*. Wollongbar: NSW Department of Primary Industries (Fisheries).

Fisheries Scientific Committee (FSC). (2010). *Final Determination to list the seagrass Posidonia australis in Port Hacking, Botany Bay, Sydney Harbour, Pittwater,* *Brisbane Waters and Lake Macquarie (NSW) as ENDANGERED POPULATIONS. Final report to NSW Department of Primary Industries*. Port Stephens.

Gartner, A., Tuya, F., Lavery, P.S., & McMahon, K. (n.d.). *Habitat preferences of macroinvertebrate fauna among seagrasses with varying structural forms. Final report to Coastal Marine Ecosystems Research Group*. Western Australia.

Gladstone, W. (2009). *Effectiveness of Seagrass-Friendly Moorings (Pittwater). Final report to the School of Environmental and Life Sciences*. Newcastle.

Gladstone, W. (2010b). *Effectiveness of Seagrass-Friendly Moorings (Pittwater). Final report to the School of Environmental and Life Sciences*. Newcastle.

Gladstone, W. (2010a). *Seagrass Friendly Moorings in Manly Cove – Report of 2010 Monitoring. Final report to Sydney Metropolitan Catchment Authority*. Sydney.

Gladstone, W. (2011). *Monitoring of Seagrass Friendly Moorings in Shoal Bay – Report of 2010 Monitoring. Final report to OnWater Marine Services Pty Ltd*. Sydney.

Gladstone, W. (2012). *Seagrass Friendly Moorings in Manly Cove – Final report of 2012 Monitoring. Final report to Sydney Metropolitan Catchment Authority*. Sydney.

Jeyco. (2013) Moorings in a Box. Retrieved 22/05/2013, from http://www.jeyco.com.au/products-and-services/mooring-systems/mooring-in-a-box.html

Kirkman, H. (1997). *Seagrasses of Australia. Final report to the Department of the Environment*. Canberra.

Lawrence, A., Baker, E. & Love, C. (2012). *Optimising and managing coastal carbon - Comparative sequestration and mitigation opportunities across Australia's landscapes and land uses. Final report to the Fisheries Research & Development Cooperation*. Sutherland.

McArthur, L., Hyndes, G., & Babcock, R. (2007). *Western rock lobster in ecosystem processes of south-western Australia. Final report to Department of Environment, Water, Heritage and the Arts*. Canberra.

McComb, A.J. & Dennison, W.C. (1999). *Case Study 18.3 – Seagrasses: Successful Marine Macrophytes*. Retrieved March 1, 2013, from University of Queensland Web site: http://plantsinaction.science.uq.edu.au/edition1/?q=content/case-study-18-3-seagrasses-successful-marine-macrophytes

McDowell, L.M., Green, D., & Griffante, D. (2009). *Adelaide Coastal Waters: Information Sheet No.2 – Seagrass health*. Adelaide: Environmental Protection Authority South Australia.

McKenzie, L. (2007). *Relationships between seagrass communities and sediment properties along the Queensland coast. Final report to Queensland Department of Primary Industries and Fisheries*. Cairns.

McKenzie, L. (2008). *Seagrass-Watch: Seagrass Educators Handbook*. Cairns: Seagrass-Watch HQ

NSW Department of Primary Industries (NSW DPI). (2013) Activities requiring a permit. Fishing and Aquaculture - NSW DPI. Retrieved 14/ 04/2013, from http://www.dpi.nsw.gov.au/fisheries/habitat/protecting-habitats/activities-requiring-a-permit

NSW Government. (2012) NSW Legislation. Fisheries Management Act 1994 No 38. Retrieved 26/02/13, from http://www.legislation.nsw.gov.au/maintop/view/inforce/act+38+1994+cd+0+N

NSW Waterways Authority. (2003). *Lake Macquarie Mooring Management Plan. Final report to NSW Government Roads and Maritime Services*. Sydney.

On Water Maine Services. (2013) Seagrass Friendly Mooring Systems. Retrieved 18/05/2013, from http://www.seagrassmooring.com.au/id17.html

Orth, R. J., Carruthers, T.J., Dennison, W.C., Duarte, C.M., Fourqurean, J.W., Heck Jr, K.L.,…Williams, S.L. (2006). A Global Crisis for Seagrass Ecosystems. *BioScience*, 56, 1-12.

Seaflex AB. (2013). *Seaflex – The Environmental Mooring Solution*. Sweden: Seaflex AB

Seagrass-Watch. (2010). *Seagrass-Watch E-Bulletin: Seagrass friendly moorings trialed in Queensland (Australia)*. Queensland: Seagrass-Watch.

SEQ Catchments. (2013) Environmentally Friendly Moorings. Retrieved 21/05/2013, from http://www.seqcatchments.com.au/case-studies/mooring-trial-to-end-crop-circles-in-moreton-bay

Shafer, D. (2002). *Recommendations to minimize potential impacts to seagrasses from single-family residential dock structures in the Pacific Northwest. Final report to the U.S. Army Corps of Engineers.* Seattle.

Short, F.T., Polidoro, B., Livingstone, S.R., Carpenter, K.E., Bandeira, S., Bujang, J.S. (2011). Extinction Risk Assessment of the World's Seagrass Species. *Biological Conservation*, 144, 1961-1971.

SIMS. (n.d.) Picture of Seagrass Friendly Mooring. Retrieved 22/05/2013, from http://www.sims.org.au/

Stewart, M. & Fairfull, S. (2007). *Primefacts: Seagrasses. Final report to NSW Department of Primary Industries*. Port Stephens, NSW.

Umwelt. (n.d.). *Seagrass Meadows and their inhabitants – Edmunds Bay*. NSW: Office of the Lake Macquarie and Catchment Coordinator.

Waters Marine. (2013) Moorings –Eco Mooring System. Retrieved 22/05/2013, from http://www.watersmarine.com.au/mooring.ews

West, R.J. (2011). Impacts of Recreational Boating Activities on the Seagrass *Posidonia* in SE Australia. *Wetlands (Australia)*, 26, 3-13.

Whitsunday Moorings and Marine Constructions. (2013) Moorings. Retrieved 21/05/2013, from http://whitsundaymoorings.com.au/moorings.htm

Zann, L.P. (1996). The State of the Marine Environment Report for Australia (SOMER): process, findings and perspectives. *Ocean & Coastal Management*, 33, 63-86.

APPENDICES

Appendix 1

Letter to Stakeholders

Southern Cross University

Southern Cross University
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Human Research Ethics Approval Number: ECN-13-071
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Dear Participant,

My name is Nathan Outerbridge. I am studying Environmental Science at Southern Cross University (SCU) and am completing my 3rd year Integrated Project, which is entitled "**An evaluation of recent trials on 'environmentally-friendly' moorings (EFMs) to inform the development of policy in New South Wales (NSW)".** My co-supervisors for the project are Dr Danny Bucher from SCU and Sarah Fairfull, Manager (Fisheries Ecosystems) from Fisheries NSW.

The aim of this report will be to evaluate the outcomes of recent "environmentally-friendly" mooring trials in Australia, and to determine whether they can be an effective alternative to traditional swing moorings to improve seagrass protection and rehabilitation. The outcomes will be used to inform the development of a NSW policy position on EFMs. The objectives of the project include:

- Identifying the importance of Australia's seagrass
- Overviewing the research on traditional swing moorings and EFMs and their impact on seagrass beds.
- Determining whether EFMs are an effective alternative to traditional swing moorings to improve seagrass protection and rehabilitation.
- Reviewing potential EFM issues, including technical aspects (design, implementation and maintenance), environmental factors that may limit effectiveness, costs and any potential liability concerns.
- Interviewing key stakeholders to determine their responses to the EFM trials.

I am seeking your feedback about the recent trials on EFMs via a questionnaire (provided with this letter), and also your opinion as a key stakeholder on the future direction of a possible NSW policy position on EFMs. If you do not wish to participate in this research, that is fine. Please advise me on the return consent form provided with this letter via email.

If you are interested, the attached questionnaire will take you approximately 10-20 minutes to complete and it will provide vital information in regards to the development of a future policy on EFMs and the direction of further research. Any information provided will not be misused and participants will be kept anonymous where possible. The questions used are not personal or offensive and will only be used for this report. Could you please note in the consent form provided whether you would like to i) complete the questionnaire and email it back to me yourself, or ii) whether you would like to complete it via phone interview with me at a time convenient to you. If you would prefer a phone interview, please advise me a date and time that suits you via email.

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CRICOS Provider: NSW 01241G, QLD 03135E, WA 02621K

Southern Cross University

To meet my project deadlines, could you please ensure the questionnaire is completed and/or your return consent form returned to me via email by **Friday, 26 April 2013**.

Thank you for your assistance with this project.

Yours sincerely,

N. Outerbridge

Nathan Outerbridge
09/04/2013

Enc – Participant consent form and questionnaire

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Appendix 2

Stakeholder Questionnaire

Issue	Stakeholder Response
Costs	
Traditional moorings cost between $750 - $1500 to install and approximately $200 a year to maintain, whilst Environmentally Friendly Moorings (EFMs) are generally more expensive (e.g. approximately $3000 and $300 annual maintenance). From the trials undertaken in Australia to date, cost appears to be a key factor limiting the uptake of EFMs. Do you agree or disagree with this comment? Why? Can you advise what you think can be done in order to reduce the costs of EFMs?	
What potential subsidies and other initiatives do you think could be used to increase the uptake of EFMs?	
Should the life cycle costing of EFMs be made available to boat owners and would this help increase uptake of EFMs?	
Technical issues – Installation and maintenance	
An issue arising from recent trials of EFMs is the need for regular and ongoing annual maintenance checks and servicing which is similar to traditional block and chain moorings. Can you see any issues for boaters with the need for the EFM to be checked on an annual basis? Are maintenance costs comparable to current moorings?	
Can you see any issues with EFM suppliers installing and maintaining EFMs?	
Do you think the trials to date have shown that EFMs are an effective alternative to traditional block and chain moorings? Why or why not? If not, what else do you think EFM suppliers can do to improve their design and use?	

Do you think that EFMs can be maintained by mooring owners? Why or why not?	
Supply of EFMs and parts	
Are the parts required for the maintenance of EFMs easy to obtain compared with the ability of sourcing parts for traditional swing moorings? If yes, how could EFM suppliers improve the availability of parts?	
Do EFM suppliers provide adequate instruction manuals which can be used by mooring contractors or mooring owners?	
Do you have any further comments to make regarding the installation and maintenance of EFMs?	
Support for the use of EFMs as an alternative to traditional swing moorings	
Do you think that EFMs can be used as an effective alternative to traditional swing moorings? Why or why not? Are you aware of any particular limitations to their use?	
During the trials of EFMs in Qld and NSW participant satisfaction with EFMs was dependent upon the issues encountered. How do you think EFMs can be improved to enhance customer satisfaction?	
How do you think EFMs can be promoted as an effective alternative to traditional swing moorings?	
Would you support a moratorium or similar process that restricted the use of traditional swing moorings in seagrass? Why or why not? What other mechanisms could be used to encourage the uptake of EFMs?	
Design	
Should a standard/accreditation process for installation and maintenance of EFMs be developed? If yes, why?	
Which EFMs do you think work well and which ones didn’t work well? Why?	

Recovery of seagrass	
Do you think EFMs contribute to the recovery and protection of seagrass? Why or why not?	
Industry development	
An issue arising during the trials was concerns that EFMs are monopolised by one main supplier. Should the government assist with the expansion of EFM suppliers? If yes, how could this be done?	
Legislation and policy on EFMs	
Should the NSW Government have a policy position on the use of EFMs? If yes, what should this policy include and why?	
Should government intervention / facilitation occur to increase EFM uptake?	
Do you think there is a need for legislative change to adopt EFMs? If yes, what would you suggest to change the legislation?	
Can regulatory red tape be reduced to enhance the uptake of EFMs? How?	
Future improvements to EFM trials	
Are you aware of any key limiting factors with the EFM trials conducted to date? What were they?	
Previous trial participants were concerned that they had to use their own insurance to cover any failures during the trial. Should the NSW Government provide insurance cover to encourage future trial participants?	
Is improved communication with boat owners needed on the outcomes of the current trials? How should this be done?	
Should more trials be undertaken and run for longer periods of time?	
Should the EFMs be tested in other environmental conditions to determine their strengths and weaknesses?	
General comments	

Do you have any other comments to add about this issue?	

Thank you for your time – please forward this completed questionnaire to Nathan Outerbridge at email: n.outerbridge.10@student.scu.edu.au