

# Long Term Management Plan – Exmouth Integrated Artificial Reef (King Reef)

## Scope, Duration, Objectives and Timeframes for Monitoring

This document describes monitoring aspects related to the integrated artificial reef which are designed to provide information that will lead to continuous improvement in the way the reef is managed and future reefs deployed. Development of a monitoring strategy to meet objectives relating to interaction with threatened and protected species and quantifying the impact of the reef system with the broader ecological community requires a time frame that is consistent with the rate of recruitment to the artificial reef system and the ecological factors which drive this process. Monitoring the structural integrity, stability, social and biological aspects will be undertaken by Recfishwest.

## Priority 1 Monitoring Objectives

The Priority 1 - Monitoring Objectives are to ensure the site selected is suitable and to monitor the structural integrity, stability and positioning of the artificial reef modules in the medium term to ensure the modules function as intended. Priority 1 - Monitoring Objectives are considered essential. These objectives have been met in determining the preferred deployment location.

### *Site Suitability*

The monitoring objective are to determine the suitability of the site in terms of:

- sediments;
- benthic communities; and
- physical and other constraints.

### *Structural Integrity and Stability*

Monitoring objectives to assess the structural integrity, stability and positioning of the artificial reef modules will continue over the life of the artificial reef and will be monitored through the Remote Underwater Video (RUV) component of Recfishwest's Reef Vision program annually for 3 years, then every 5 years until year 18. A final inspection for structural integrity will be made after 28 years. Footage from the reef vision program will be provided to a qualified marine engineer who will use this footage to:

- assess the ongoing structural integrity of the artificial reef modules;
- assess the ongoing stability and position of the artificial reef modules;
- document any significant changes to areas immediately around the artificial reef post installation including excessive scouring and/or excessive sedimentation; and
- document any other changes, such as fouling by fishing gear and anchors, extent of marine growth and evidence of corrosion.

The Integrated Artificial Reef has been designed to withstand a 1-in-100yr storm event. It is our intent that an inspection be undertaken no more than six weeks following a large storm event (1-in-100yr). The Reef Vision footage will provide the opportunity to observe and provide photographic evidence of any significant changes in the adjacent sediments or benthos, and any fouling by fishing gear or anchors. Divers will only be employed if there is evidence of significant deterioration in the structural integrity of modules indicating possible structural failure. Fouling debris may be removed by divers if it is deemed excessive. Based on recent survey of the Geographe Bay artificial reefs fouling by fishing gear or anchors is not expected to be significant. In the event that footage from the Reef Vision program is unable to provide the quality or quantity of footage required to make an assessment of module stability alternate video footage will be obtained from a third party diving operator.

### **Priority 2 Monitoring Objectives**

Priority 2 – Monitoring Objectives have been studied for artificial reefs in several other places including the Perth, Dunsborough and Bunbury artificial reefs. Recfishwest will actively engage with the Department of Primary Industries and Regional Development to address these objectives when funding and/or other resources are available. Recfishwest will also support applications for funding that will address Priority 2 - Monitoring Objectives. In addition, footage from Recfishwest's Reef Vision program will also be made available to assess Priority 2 – Monitoring Objectives along with the other reef vision components which include log books, online surveys, observational posts and boat ramp interviews.

### ***Social and Economic Objectives***

The social and economic objectives are to:

- document the use of the Integrated Artificial Reef by recreational fishers;
- compare survey data (where available) to identify changes in fisher behaviour;
- document the reasons why fishers use the Exmouth Integrated Artificial Reef;
- analyse other information available of the social/economic impacts of artificial reefs (e.g. on divers and non-extractive users, ecotourism including whale watching, commercial fishing displacement and on non-fishery users such as tourists on beaches);
- document effectiveness in terms of popularity with recreational fishing groups; and
- identify issues of conflict between user groups.

### ***Biological and Ecological Objectives***

The biological and ecological objectives are to:

- document presence and composition of target species in the reef area;
- document non target species presence and composition;
- document the fishing activities (effort and catch, and species composition) on the integrated artificial reef; and
- provide an opportunity to investigate occurrence of threatened/protected and migratory species.

In addition to the Planned Priority 2 - Monitoring Objectives, all footage collected will be provided to the Department of Primary Industries and Regional Development Biodiversity and Biosecurity Branch upon request, if an IMS is identified by an analyst, providing an opportunity to document colonisation of the reef structures by pest species and monitor for the presence of threatened or endangered species. Any pest, threatened or endangered species that are identified at the reef during the course of the long term monitoring will be forwarded to the relevant authorities such as The Department of Environment, Department of Primary Industries and Regional Development and Department of Parks and Wildlife.

### **Recfishwest's Reef Vision Program**

Reef Vision involves monitoring social and biological/ecological utilisation of the reef through observation posts, logbooks and underwater monitoring using Baited Remote Underwater Video systems (BRUVs). The ability to monitor structural stability of artificial reef modules is also being explored through the use of side- scan sonar.

Recfishwest currently has 40 community volunteers who each collect 2 hours of footage of the Mandurah, Dunsborough and Bunbury artificial reefs every month providing over 280 hours of footage of the artificial reefs spread evenly throughout the year. It is Recfishwest's intention to expand the current Reef Vision program to include monitoring of the Exmouth Integrated Artificial Reef with several community members already enquiring about joining the program. The BRUV component uses custom made underwater video systems utilised by volunteer recreational fishers and divers to collect underwater footage of the fish faunal communities around the artificial reefs.

Applicants for the Reef Vision program are evaluated and filtered to reduce potential attrition rates. Successful applicants attend a workshop (Figure 1) to train Reef Vision volunteers on how to use the BRUV units; they are also supplied with a package containing information and equipment to record metadata (Figure 3). The BRUV unit given to the volunteers includes a GoPro Hero 4TM camera attached to a 5kg frame tied to 25m of rope attached to a buoy (Figure 2).



Figures 1 and 2: Reef Vision traineeship program (left) and volunteer deploying BRUV unit (right).



Figure 3: Volunteer reef vision kit.

Footage from the Reef Vision program taken in close proximity to the reef modules will be recorded and compiled into a collection that will be provided to a suitable qualified marine engineer to help assess structural integrity, positioning and any scouring of the modules. The quality of footage being gathered by the Reef Vision team can be seen in Figures 4 & 5 (following page).



Figure 4. Reef module showing growth.



Figure 5. Assessment of the structural integrity.

### **Priority 1 - Monitoring and Frequency Timeline**

The frequency and period over which it is intended that components of Priority 1 & 2 Monitoring Objectives for the Exmouth Integrated Artificial Reef will be undertaken are shown in Table 1 & 2. Structural integrity, stability and positioning will be provided to Department of the Environment and Energy (DEE). Any pest, threatened or endangered species that are identified at the reef during the course of the long term monitoring plan will be provided to the Department of Primary Industries and Regional Development (DPIRD), Department of Parks and Wildlife and DEE (the timeline can be seen on the following pages).

**Table 1. Planned Priority 1 Monitoring and frequency.**

<b>Date</b>	<b>Objective</b>	<b>Method</b>	<b>Outcome</b>	<b>Submission</b>
May 2018	<ul style="list-style-type: none"> <li>• Monitor for protected species interaction</li> </ul>	<ul style="list-style-type: none"> <li>• Protected species watch</li> </ul>	<ul style="list-style-type: none"> <li>• Document cetacean interaction</li> </ul>	<ul style="list-style-type: none"> <li>• DEE</li> </ul>
May 2018	<ul style="list-style-type: none"> <li>• Varication of competency – Reef Vision</li> </ul>	<ul style="list-style-type: none"> <li>• Reef Vision</li> <li>• Seek applications and select participants</li> <li>• Train and equip participants</li> <li>• First recordings from Reef Vision project team received. Reef Vision monitoring will occur throughout the year with each participant recording two hours of footage every month.</li> </ul>	<ul style="list-style-type: none"> <li>• monitoring social and biological/ecological utilization of the reef</li> </ul>	<ul style="list-style-type: none"> <li>• DEE</li> </ul>
< 6 weeks from deploy ment	<ul style="list-style-type: none"> <li>• Monitoring the structural integrity, stability and positioning of the artificial reef modules.</li> </ul>	<ul style="list-style-type: none"> <li>• Remote underwater video recording</li> <li>• GPS validation via sonar</li> </ul>	<ul style="list-style-type: none"> <li>• Assess the ongoing stability and position of the artificial reef modules</li> <li>• Document any significant changes to areas immediately around the artificial reef post installation including excessive scouring and/or excessive sedimentation</li> </ul>	<ul style="list-style-type: none"> <li>• DEE</li> </ul>
Feb 2018	<ul style="list-style-type: none"> <li>• Monitoring the structural integrity, stability and positioning of the artificial reef modules.</li> </ul>	<ul style="list-style-type: none"> <li>• Remote underwater video recording</li> <li>• GPS validation via sonar</li> <li>• Removal of fouling (if Required)</li> <li>• Additional video monitoring (if required)</li> </ul>	<ul style="list-style-type: none"> <li>• Assess the ongoing structural integrity of the artificial reef modules</li> <li>• Assess the ongoing stability and position of the artificial reef modules</li> <li>• Document any significant changes to areas immediately around the artificial reef post installation including excessive scouring and/or excessive sedimentation</li> <li>• Document any other changes, such as fouling by fishing gear and anchors, extent of marine growth and evidence of corrosion</li> </ul>	<ul style="list-style-type: none"> <li>• DEE</li> </ul>
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Feb 2029	<ul style="list-style-type: none"> <li>Monitoring the structural integrity, stability and positioning of the artificial reef modules.</li> </ul>	<ul style="list-style-type: none"> <li>Remote underwater video recording</li> <li>GPS validation via sonar</li> <li>Removal of fouling (if Required)</li> <li>Additional video monitoring (if required)</li> </ul>	<ul style="list-style-type: none"> <li>Assess the ongoing structural integrity of the artificial reef modules</li> <li>Assess the ongoing stability and position of the artificial reef modules</li> <li>Document any significant changes to areas immediately around the artificial reef post installation including excessive scouring and/or excessive sedimentation</li> <li>Document any other changes, such as fouling by fishing gear and anchors, extent of marine growth and evidence of corrosion</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>
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Feb 2039	<ul style="list-style-type: none"> <li>Monitoring the structural integrity, stability and positioning of the artificial reef modules.</li> </ul>	<ul style="list-style-type: none"> <li>Remote underwater video recording</li> <li>GPS validation via sonar</li> <li>Removal of fouling (if Required)</li> <li>Additional video monitoring (if required)</li> </ul>	<ul style="list-style-type: none"> <li>Assess the ongoing structural integrity of the artificial reef modules</li> <li>Assess the ongoing stability and position of the artificial reef modules</li> <li>Document any significant changes to areas immediately around the artificial reef post installation including excessive scouring and/or excessive sedimentation</li> <li>Document any other changes, such as fouling by fishing gear and anchors, extent of marine growth and evidence of corrosion</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>
Feb 2044	<ul style="list-style-type: none"> <li>Monitoring the structural integrity, stability and positioning of the artificial reef modules.</li> </ul>	<ul style="list-style-type: none"> <li>Remote underwater video recording</li> <li>GPS validation via sonar</li> <li>Removal of fouling (if Required)</li> <li>Additional video monitoring (if required)</li> </ul>	<ul style="list-style-type: none"> <li>Assess the ongoing structural integrity of the artificial reef modules</li> <li>Assess the ongoing stability and position of the artificial reef modules</li> <li>Document any significant changes to areas immediately around the artificial reef post installation including excessive scouring and/or excessive sedimentation</li> <li>Document any other changes, such as fouling by fishing gear and anchors, extent of marine growth and evidence of corrosion</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>



Feb 2047	<ul style="list-style-type: none"> <li>Monitoring the structural integrity, stability and positioning of the artificial reef modules.</li> </ul>	<ul style="list-style-type: none"> <li>Remote underwater video recording</li> <li>GPS validation via sonar</li> <li>Removal of fouling (if Required)</li> <li>Additional video monitoring (if required)</li> </ul>	<ul style="list-style-type: none"> <li>Assess the ongoing structural integrity of the artificial reef modules</li> <li>Assess the ongoing stability and position of the artificial reef modules</li> <li>Document any significant changes to areas immediately around the artificial reef post installation including excessive scouring and/or excessive sedimentation</li> <li>Document any other changes, such as fouling by fishing gear and anchors, extent of marine growth and evidence of corrosion</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>
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## Planned Priority 2 - Monitoring and Frequency Timeline

Table 2. Planned Priority 2 Monitoring and frequency.

Date	Objective	Method	Outcome	Submission
May 2018	<ul style="list-style-type: none"> <li>Monitoring Social and Economic impact</li> </ul>	<ul style="list-style-type: none"> <li>Meeting and presentations with Fishing clubs and Associations</li> <li>Social media (Creation of facebook page for the reef, identification of usage)</li> <li>Survey of reef usage and user drivers</li> <li>Log books</li> </ul>	<ul style="list-style-type: none"> <li>Document the use of the Artificial Reef by recreational fishers</li> <li>Compare to survey data (where available) to identify changes in fisher behaviour</li> <li>Document the reasons why fishers use the Artificial Reef</li> <li>Analyse other information available of the social/economic impacts of artificial reefs (e.g. On Divers and non-extractive users, ecotourism including whale watching, commercial fishing</li> <li>Displacement and on non-fishery users such as tourists on beaches)</li> <li>Document effectiveness in terms of popularity with recreational fishing groups</li> <li>Identify issues of conflict between user groups.</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>
May 2018	<ul style="list-style-type: none"> <li>Monitoring Biological and Ecological impact</li> </ul>	<ul style="list-style-type: none"> <li>Log books</li> <li>Reef Vision</li> <li>Catch monitoring through social media</li> <li>Catch cards</li> <li>Surveys</li> <li>Boat ramp interview</li> </ul>	<ul style="list-style-type: none"> <li>Investigate presence of target species in the reef area.</li> <li>Document non target species composition and abundance.</li> <li>Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>Provide an opportunity to investigate occurrence of threatened/protected and migratory</li> <li>Investigate presence of target species in the reef area.</li> <li>Document non target species composition and abundance.</li> <li>Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>Provide an opportunity to investigate occurrence of threatened/protected and migratory species.</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>

May 2018		Any pest, threatened or endangered species that are identified at the reef during the course of the long term monitoring plan will be forwarded to the relevant authorities		<ul style="list-style-type: none"> <li>• DEE</li> <li>• DPIRD</li> <li>• DPW</li> </ul>
May 2019	<ul style="list-style-type: none"> <li>• Monitoring Social and Economic impact</li> </ul>	<ul style="list-style-type: none"> <li>• Meeting and presentations with Fishing clubs and Associations</li> <li>• Social media (Creation of facebook page for the reef, identification of usage)</li> <li>• Survey of reef usage and user drivers</li> <li>• Log books</li> </ul>	<ul style="list-style-type: none"> <li>• Document the use of the Artificial Reef by recreational fishers</li> <li>• Compare to survey data (where available) to identify changes in fisher behaviour</li> <li>• Document the reasons why fishers use the n Artificial Reef</li> <li>• Analyse other information available of the social/economic impacts of artificial reefs (e.g. On</li> <li>• Divers and non-extractive users, ecotourism including whale watching, commercial fishing</li> <li>• Displacement and on non-fishery users such as tourists on beaches)</li> <li>• Document effectiveness in terms of popularity with recreational fishing groups</li> <li>• Identify issues of conflict between user groups.</li> </ul>	<ul style="list-style-type: none"> <li>• DEE</li> </ul>
May 2019	<ul style="list-style-type: none"> <li>• Monitoring Biological and Ecological impact</li> </ul>	<ul style="list-style-type: none"> <li>• Log books</li> <li>• Reef Vision</li> <li>• Catch monitoring through social media</li> <li>• Catch cards</li> <li>• Surveys</li> <li>• Boat ramp interview</li> </ul>	<ul style="list-style-type: none"> <li>• Investigate presence of target species in the reef area.</li> <li>• Document non target species composition and abundance.</li> <li>• Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>• Provide an opportunity to investigate occurrence of threatened/protected and migratory</li> <li>• Investigate presence of target species in the reef area.</li> <li>• Document non target species composition and abundance.</li> <li>• Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>• Provide an opportunity to investigate occurrence of threatened/protected and migratory species.</li> </ul>	<ul style="list-style-type: none"> <li>• DEE</li> </ul>
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Feb 2024	Any pest, threatened or endangered species that are identified at the reef during the course of the long term monitoring plan will be forwarded to the relevant authorities			<ul style="list-style-type: none"> <li>DEE</li> <li>DPIRD</li> <li>DPW</li> </ul>
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Feb 2034	Any pest, threatened or endangered species that are identified at the reef during the course of the long term monitoring plan will be forwarded to the relevant authorities			<ul style="list-style-type: none"> <li>DEE</li> <li>DPIRD</li> <li>DPW</li> </ul>
Feb 2039	<ul style="list-style-type: none"> <li>Monitoring Social and Economic impact</li> </ul>	<ul style="list-style-type: none"> <li>Meeting and presentations with Fishing clubs and Associations</li> <li>Social media (Creation of facebook page for the reef, identification of usage)</li> <li>Survey of reef usage and user drivers</li> <li>Log books</li> </ul>	<ul style="list-style-type: none"> <li>Document the use of the Artificial Reef by recreational fishers</li> <li>Compare to survey data (where available) to identify changes in fisher behaviour</li> <li>Document the reasons why fishers use the Artificial Reef</li> <li>Analyse other information available of the social/economic impacts of artificial reefs (e.g. On Divers and non-extractive users, ecotourism including whale watching, commercial fishing</li> <li>Displacement and on non-fishery users such as tourists on beaches)</li> <li>Document effectiveness in terms of popularity with recreational fishing groups</li> <li>Identify issues of conflict between user groups.</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>

Feb 2039	<ul style="list-style-type: none"> <li>Monitoring Biological and Ecological impact</li> </ul>	<ul style="list-style-type: none"> <li>Log books</li> <li>Reef Vision</li> <li>Catch monitoring through social media</li> <li>Catch cards</li> <li>Surveys</li> <li>Boat ramp interview</li> </ul>	<ul style="list-style-type: none"> <li>Investigate presence of target species in the reef area.</li> <li>Document non target species composition and abundance.</li> <li>Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>Provide an opportunity to investigate occurrence of threatened/protected and migratory</li> <li>Investigate presence of target species in the reef area.</li> <li>Document non target species composition and abundance.</li> <li>Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>Provide an opportunity to investigate occurrence of threatened/protected and migratory species.</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>
Feb 2039	Any pest, threatened or endangered species that are identified at the reef during the course of the long term monitoring plan will be forwarded to the relevant authorities			<ul style="list-style-type: none"> <li>DEE</li> <li>DPIRD</li> <li>DPW</li> </ul>
Feb 2044	<ul style="list-style-type: none"> <li>Monitoring Social and Economic impact</li> </ul>	<ul style="list-style-type: none"> <li>Meeting and presentations with Fishing clubs and Associations</li> <li>Social media (Creation of facebook page for the reef, identification of usage)</li> <li>Survey of reef usage and user drivers</li> <li>Log books</li> </ul>	<ul style="list-style-type: none"> <li>Document the use of the Artificial Reef by recreational fishers</li> <li>Compare to survey data (where available) to identify changes in fisher behaviour</li> <li>Document the reasons why fishers use the Artificial Reef</li> <li>Analyse other information available of the social/economic impacts of artificial reefs (e.g. On Divers and non-extractive users, ecotourism including whale watching, commercial fishing</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>
			<ul style="list-style-type: none"> <li>Displacement and on non-fishery users such as tourists on beaches)</li> <li>Document effectiveness in terms of popularity with recreational fishing groups</li> <li>Identify issues of conflict between user groups.</li> </ul>	

Feb 2044	<ul style="list-style-type: none"> <li>Monitoring Biological and Ecological impact</li> </ul>	<ul style="list-style-type: none"> <li>Log books</li> <li>Reef Vision</li> <li>Catch monitoring through social media</li> <li>Catch cards</li> <li>Surveys</li> <li>Boat ramp interview</li> </ul>	<ul style="list-style-type: none"> <li>Investigate presence of target species in the reef area.</li> <li>Document non target species composition and abundance.</li> <li>Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>Provide an opportunity to investigate occurrence of threatened/protected and migratory</li> <li>Investigate presence of target species in the reef area.</li> <li>Document non target species composition and abundance.</li> <li>Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>Provide an opportunity to investigate occurrence of threatened/protected and migratory species.</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>
Feb 2044	Any pest, threatened or endangered species that are identified at the reef during the course of the long term monitoring plan will be forwarded to the relevant authorities			<ul style="list-style-type: none"> <li>DEE</li> </ul>
Feb 2047	<ul style="list-style-type: none"> <li>Monitoring Social and Economic impact</li> </ul>	<ul style="list-style-type: none"> <li>Meeting and presentations with Fishing clubs and Associations</li> <li>Social media (Creation of facebook page for the reef, identification of usage)</li> <li>Survey of reef usage and user drivers</li> <li>Log books</li> </ul>	<ul style="list-style-type: none"> <li>Document the use of the Artificial Reef by recreational fishers</li> <li>Compare to survey data (where available) to identify changes in fisher behaviour</li> <li>Document the reasons why fishers use the Artificial Reef</li> <li>Analyse other information available of the social/economic impacts of artificial reefs (e.g. On Divers and non-extractive users, ecotourism including whale watching, commercial fishing</li> <li>Displacement and on non-fishery users such as tourists on beaches)</li> <li>Document effectiveness in terms of popularity with recreational fishing groups</li> <li>Identify issues of conflict between user groups.</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>
Feb 2047	<ul style="list-style-type: none"> <li>Monitoring Biological and Ecological impact</li> </ul>	<ul style="list-style-type: none"> <li>Log books</li> <li>Reef Vision</li> <li>Catch monitoring through social media</li> <li>Catch cards</li> <li>Surveys</li> <li>Boat ramp interview</li> </ul>	<ul style="list-style-type: none"> <li>Investigate presence of target species in the reef area.</li> <li>Document non target species composition and abundance.</li> <li>Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>Provide an opportunity to investigate occurrence of threatened/protected and migratory</li> <li>Investigate presence of target species in the reef area.</li> <li>Document non target species composition and abundance.</li> <li>Document the fishing activities (effort and catch, and species composition) on the Artificial Reef</li> <li>Provide an opportunity to investigate occurrence of threatened/protected and migratory species.</li> </ul>	<ul style="list-style-type: none"> <li>DEE</li> </ul>
Feb 2047	Any pest, threatened or endangered species that are identified at the reef during the course of the long term monitoring plan will be forwarded to the relevant authorities			<ul style="list-style-type: none"> <li>DEE</li> </ul>