

1.0 INTRODUCTION

Establishment of the national artificial reef plan pursuant to the National Fishing Enhancement Act of 1984 (Public Law 98-623) provided guidelines for artificial reef development in state and federal waters. The federal act paved the way for the development of state artificial reef plans which could account for regional parameters. The passage of the Louisiana Fishing Enhancement Act (Act 100) during the 1986 regular legislative session further defined Louisiana's position to promote and facilitate artificial reef development. The Louisiana Artificial Reef Development Program (Program) was developed within the Louisiana Department of Wildlife and Fisheries to administer the Program and is overseen by the Louisiana Artificial Reef Development Council.

The Program has become well established since its inception in 1986 and adoption of the Louisiana Artificial Reef Plan in 1987. The Program has had remarkable success with its offshore rigs-to-reef program and has become a model for similar programs around the world. The success and achievements offshore have allowed the development of a nearshore and numerous inshore artificial reefs throughout the years. Per the original intent of the 1987 Artificial Reef Plan, this document is intended to supplement the Louisiana Artificial Reef Plan and serve as a guide to further the establishment and maintenance of inshore and nearshore artificial reefs.

1.1 Phase II Plan Rationale

The implementation of an inshore and nearshore artificial reef development plan requires the understanding of the biological, legal, technical, social and economic aspects associated with the respective type of artificial reef development. There are notable differences in developing an inshore or nearshore reef versus an offshore artificial reef. Inshore and nearshore areas are typically in areas of high use by numerous user groups, located in relatively shallow water, subject to high energy events, and have additional permitting requirements.

This inshore and nearshore plan has been drafted as a supplement to the Louisiana Artificial Reef Plan. The Program will continue the responsible planning, siting, material selection, permitting, and monitoring of inshore and nearshore artificial reef development. This is a compilation of the Program's reef development experience, scientific information available, review of other states' management plans, and adherence to the National Artificial Reef Plan. This document will serve as a foundation from which to build an adaptive management approach to the inshore and nearshore reef development process.

1.2 Artificial Reef Definitions

Artificial reefs are defined by Seaman (2000) as "one or more objects of natural or human origin deployed purposefully on the seafloor to influence physical, biological, or socioeconomic processes related to living marine resources." Artificial reefs are used as a management tool to enhance habitat

and fisheries, along with providing additional access to the marine resources. Inshore and nearshore artificial reefs have been deployed in all of the Gulf coast states, and have been reported to enhance fishing experience.

Before going further it is important to provide the definition for the terms inshore, nearshore, and offshore artificial reefs within the context of the Program and this document. Inshore reefs are those artificial reefs developed solely in Louisiana state waters between the Louisiana Intracoastal Waterway and the Louisiana coastline and within Lake Pontchartrain. Nearshore reefs are those artificial reefs developed in either State or Federal waters between the coastline of Louisiana and the 100 foot depth contour. Louisiana offshore reefs are those artificial reefs developed solely in federal waters between the 100 foot contour and the U.S. Economic Exclusive Zone boundary.

Inshore and nearshore reefs can be utilized by a greater number of Louisiana's fishermen due to shorter travel distances and provide options to stay closer to shore or inshore during inclement weather conditions. Local fishing clubs, charter operations, and conservation associations continue to express interest in the development of inshore and nearshore reefs.

The nearshore program will seek to reef oil and gas structures, as an alternative to decommissioning, which results in the loss of fisheries habitat and fishing opportunities. The Program presently reefs oil and gas structures offshore via the Rigs to Reefs program. The nearshore program will operate in similar fashion to Rigs to Reefs, with the notable exception that nearshore reefs will be at depths 100 feet or less. The Program will seek to preserve as much habitat as practicable, by keeping the base of the structure, rockpiles, and unique profile features when they are present. While the Program will not preclude the possibility of accepting the jackets of these structures, the shallower permitted clearances will often prevent the jackets from remaining at nearshore reef sites. Prior to the development of any artificial reef, whether inshore or nearshore, it is important to identify the primary purpose of the artificial reef. All factors should be considered for any artificial reef development; however certain factors can be weighted based on the desired purpose of the artificial reef. For instance, habitat enhancement for a particular species requires the environmental and biological factors to be of foremost importance in reef design and development; whereas social and economic considerations are primary factors in developing reef habitat intended primarily to increase access and opportunities. Defining the purpose and prioritizing the artificial reef development standards for each artificial reef will set the expectations and determine an artificial reefs overall success.

2.0 INSHORE AND NEARSHORE NATIONAL AND STATE OBJECTIVES

2.1 National Artificial Reef Plan Objectives

Per the National Fishing Enhancement Act and Louisiana Fishing Enhancement Act, artificial reefs shall be sited, constructed, and subsequently maintained, monitored, and managed based upon the best scientific information available, and in a manner which shall:

- (1) Enhance and conserve fishery resources to the maximum extent practicable.

- (2) Facilitate access and utilization by recreational and commercial user groups.
- (3) Minimize conflicts among competing uses of waters and the resources in such waters.
- (4) Minimize environmental risks and risks to personal and public health and property.
- (5) Be consistent with generally accepted principles of international law and national fishing law, and not create any unreasonable obstructions to navigation.

2.2 Louisiana Artificial Reef Plan Objectives

Louisiana's inshore and nearshore waters are variable and applying strict guidelines that pertain to all situations proves challenging. In addition to the National and State standards the guidelines within this document will serve to direct the development of inshore and nearshore artificial reef development. This is intended to be a dynamic working document which establishes guidelines for planning, siting, constructing and monitoring inshore and nearshore reefs.

The focus of phase II reef development is as follows:

- Enhance inshore and nearshore fishing opportunities and have a net positive impact to fisheries;
- Reduce or eliminate conflict between user groups;
- Utilize reefs as a fisheries management tool
- Construct new reefs based on siting criteria and input expressed by advisory organizations, the fishing public, and other constituents;
- Increase accessibility;
- Site reefs with long-term economic and social impacts of the community in mind; and
- Evaluate reef performance frequently in regard to economic, social and biological impacts and inform artificial reef constituents

3.0 SITE SELECTION

Artificial reef siting is a process of establishing the best location for reef development based on certain essential factors. Exclusion mapping, a method developed by the Artificial Reef Development Center, narrows down suitable areas for reef development by eliminating unsuitable areas. The suitable areas can then be targeted for detailed study. There are many environmental and economic factors that can contribute to an area being deemed suitable or unsuitable, making the inshore siting process complex.

Appropriately siting inshore or nearshore artificial reefs can be challenging in relatively shallow navigable waters. The creation of an inshore or nearshore reef may benefit several user groups while impacting others. Identifying the user groups and historical uses for a particular area is an important aspect in minimizing potential conflicts. Equally important is the historical use of an area by migratory or established species. Alteration of the habitat and subsequent changes in use of an area should be taken into consideration with regards to artificial reef development.

The creation of new inshore and nearshore reef sites will be selected on a case by case basis. The Program's geographical information system (GIS) will serve as the foundation for identifying potential areas for artificial reef development. The mapping system contains easily updated data sets which allow near continuous exclusion and inclusion mapping processes. New data sets can be effortlessly added. GIS will allow for the identification of potential development areas based on known and available factors. The exclusion and inclusion mapping method will be further vetted with other factors which are not available that do not lend themselves to GIS data layers.

3.1 Siting factors

The following siting factors are applicable to the development of artificial reefs. These criteria will be used to delineate or target areas for artificial reef development.

3.1.1 Environmental/Biological Factors

General Habitat Quality

The environmental qualities of a selected site should be of sufficient quality to support the biota that are likely or intended to be recruited. General water quality parameters such as salinity, temperature, dissolved oxygen levels and currents will be taken into consideration when siting an artificial reef. It would be unproductive to place artificial reefs in areas with high fecal coliform counts, historical low dissolved oxygen episodes, and continued exposure to pollutants. The development of an artificial reef should not interfere with known migratory patterns or spawning grounds of fishes and marine mammals.

Salinity

Salinity will affect species recruitment at and onto artificial reefs. Louisiana's inshore and nearshore waters have a wide range of salinity levels, from fresh to full seawater, and will fluctuate more often in some areas of the coast than others. The salinity regime is of utmost importance if the habitat is being developed to enhance a particular species, especially if it is a sessile organism. The biological community will be more stable in areas where the salinity regime remains fairly constant. Widely fluctuating salinities may affect the desired function of an artificial reef. Desired species may only use the area when salinity conditions are appropriate.

Temperature

Temperature, like salinity, will influence species presence at artificial reefs. Water will experience a wider range of temperatures in shallow water than in deeper water. Inshore water temperature will fluctuate seasonally, being warmer in summer than in winter, causing seasonal changes in species presence.

Current

Areas subject to high current velocity are susceptible to scouring and sediment shifting; areas of low current are more suitable for reef construction. Water movements in coastal Louisiana are generally sluggish due to low land relief and small tidal range; therefore, normal water currents movements will not be a primary factor in siting most inshore reefs.

Water Depth and Reef Clearance

Clearance over an artificial reef is a critical variable and is directly tied to water depth. Louisiana's inshore waters and the nearshore continental shelf are relatively shallow. Sufficient water depth is necessary to accommodate the material being deployed while meeting U.S. Coast Guard navigational clearance requirements over the artificial reef upon completion. The combination of water depth, clearance, and U.S. Coast Guard marking requirements will determine the maximum profile available for reef development. Inshore reefs typically require a minimum 6 foot clearance at Mean Lower Low Water (MLLW); therefore requiring inshore reefs to be constructed of low profile materials to meet navigation requirements. Nearshore and offshore reefs typically require an 85 foot MLLW clearance to be granted a waiver of marking requirements. In rare instances a waiver of marking requirements may be granted for nearshore and offshore reefs with at least 50 foot MLLW clearance. Offshore and nearshore reefs with less than 50 MLLW are typically required to be marked permanently. The navigational clearance and marking requirements of each artificial reef is based on factors evaluated by the U.S. Coast Guard and determined on a case by case basis.

Substrate

In the bays and lakes of coastal Louisiana, the surficial sediments are comprised predominantly of silty clays, clayey silts, and silty sands (Barrett 1971). Surveys and groundtruthing should be conducted to identify and confirm the suitability of the sediment for the reef material being deployed. Generally, soft mud is unsuitable for artificial reef deployment; however, certain materials are better suited for soft mud than others and can be deployed with reduced movement and subsidence risks.

Storm Events

Louisiana's coast is subject to storm events throughout the year. These events range from summer squalls to large damaging hurricanes. Winter Gulf storms and blue norther's can equally affect the inshore and nearshore coastal waters. These events can have varying effects on the salinity, temperature, and currents. While these events cannot be controlled, it is important to develop the artificial reefs with appropriate materials which will remain intact, on location, and not pose a risk to surrounding areas. Equally important is to located the reef in an area where it will not be buried the material subsides due to storm events.

Biologically Sensitive Areas

The development of an artificial reef is a tradeoff between the existing biological community at the selected location and the desired biological community. The addition artificial reef material will modify and/or displace the existing organisms.

Those areas identified as biologically sensitive such as natural reefs, grassbeds, bivalve beds, or live bottoms will not be considered for artificial reef development. A buffer of 1000 feet at minimum will be established between identified biologically sensitive areas and artificial reef development to protect the sensitive areas from potential adverse impacts.

However, in some cases artificial reef materials mimicking the natural habitat might be beneficial in areas with sparse natural assemblages or in proximity to biologically productive areas. Properly placed and designed artificial reefs can further enhance or divert pressure from natural biological areas.

Complexity

Complexity is an important factor for the success of an artificial reef. This includes design, spatial arrangement, number of chambers and openings, and the amount of interstitial space. In general more diverse biological communities develop around reef materials or designs exhibiting greater structural complexity.

3.1.2 Social Factors

User Groups

One of the principal objectives of artificial reef development is to minimize user conflict. Identifying the user groups and historical uses for a particular area is an important aspect in minimizing potential conflicts. The creation of an inshore reef may benefit several user groups while impacting others and these impacts will be considered. User groups to be considered, but not limited to, are

- Commercial Fishing Interests
 - Menhaden Industry
 - Oyster Fishermen
 - Reef Fishermen
 - Trawlers
- Conservation Groups
- Oil and Gas Interests
- Recreational Interests
 - Charter boats/Head boats
 - Private Anglers
 - Sailing
 - Scuba divers

The following are standards, related to specific user groups that have been and will continue to be used in developing artificial reefs.

Navigation

Artificial reef development shall not create any unreasonable obstructions to navigation. Care should be taken to minimize impacts on existing navigation or hindrance created by the reef's creation or use.

Shipping channels, designated anchorages, tidal inlets, or areas of heavy navigational traffic will not be considered for artificial reef development.

Oil & Gas Infrastructure

Oil & Gas structures are a common feature and fishing location in Louisiana state waters, which has contributed to the success of the rigs to reefs program. The nearshore program will site reef locations in a manner modeled after the rigs to reefs program, targeting oil and gas structures scheduled for decommissioning.

The inshore program, however, will seek to avoid oil and gas infrastructure, primarily due to the many pipelines associated with these structures. A minimum distance of 1000 feet will be maintained between reef development and active structures and pipelines.

Oyster Leases

According to RS56:423, private oyster lease holders have virtually the same rights as if they owned the water bottom. Development of artificial reefs on private leases would have to be done so with lessee's consent and the owner would have the right to harvest the area. Therefore, artificial reefs developed in Louisiana's state waters will not consider private oyster leases for artificial reef development. A minimum of 1000 feet will be maintained between reef development and oyster leases.

Accessibility

Many artificial reefs are developed to enhance fishing opportunities. Inshore and nearshore reefs, for this purpose, will require shorter travel distances to allow utilization by a higher number of Louisiana's recreational fishermen. Reef development will take into account high population centers, proximity to boat launches and marinas into consideration for ease of access when developing artificial reefs to increase fishing opportunities. Accessibility will be of lesser importance for inshore and nearshore reefs developed for species management, research, or other designated purposes.

Public Support

A high degree of support from the public and associated user groups is crucial when selecting sites for artificial reef development. Information from users and commission groups provide keen insight on areas targeted for reef development. Support will have a significant influence on the placement of artificial reefs, provided other required factors and permitting can be obtained.

3.2 Economic Siting Factors

The development of an artificial reef must be economical not only in the sense of acquiring and deploying reef material, but also from a long-term maintenance, management and liability perspective. Costs also include lost opportunity by other user groups which cannot use the area because of the artificial reef. The benefits from the artificial reef should outweigh the long-term costs. Projected benefits are enhanced fishing opportunities and non-use ecological benefits of the artificial reef. Proper

site selection is the key to balancing the economic factors so that an artificial reef has a net positive economic and biological effect. Developing reefs with appropriate material requiring little or no maintenance and in areas where marking is not required or minimal will ensure long-term success of not only the artificial reefs, but also the Program.

Funding for the Program comes from the donations through the offshore rigs to reef program which are deposited into the Reef Fund. Act 237 of the 2011 legislative session allows LDWF to provide funding for inshore fisheries habitat enhancement projects up to an amount of not more than 10 percent of the donations deposited each year. Such funding may be used for grants to nonprofit conservation organizations developing fisheries habitat. Money, material, labor, or in kind services may be donated by non-profit, private, or governmental agencies in support of artificial reef development.

4.0 MATERIALS

“Materials of opportunity” or “secondary use” materials have been commonly used in artificial reef development in the United States. Prior to 2003, Louisiana inshore artificial reefs had only been developed with natural shell or #57 limestone which mimicked the natural environment. In 2003, the experimental deployment of 680 prefabricated reef modules, reef balls, in Lake Pontchartrain was the first use of higher profile man-made material by the Department. A study by the University of New Orleans confirmed the efficacy of the reef balls as artificial reef habitat. The 2004, 2005, and 2008 hurricane seasons tested the reef balls long-term stability and durability. Side scans surveys following the hurricane seasons, confirmed that the reef balls had remained intact, on location, and exhibited little or no subsidence. The results allowed the development of 4 additional reefs in Lake Pontchartrain in 2009 with 600 additional pre-fabricated reef balls.

Hurricane Katrina proved to be detrimental to the I-10 Twin Spans, but provided an opportunity for inshore artificial reef development. Two 4 acre artificial reef sites were created with over 25,000 tons of recycled bridge material. The recycled bridge spans were systematically dismantled and processed to material specifications in order to adhere to permits and reef material requirements of the two artificial reefs. Properly recycled “secondary use” materials such as clean concrete free of protruding reinforcement material (i.e., rebar) which meet an artificial reef site’s specifications can be a cost effective alternative to quarried limestone.

When considering materials for reef development, the determination for use will be based on the National Artificial Reef Plan, current regulations, past reef development experiences, and the experiences of other state artificial reef programs. All reef material “shall be free of pollutants and toxins” in accordance with U.S Coast Guard, U.S. Environmental Protection Agency and Louisiana Department of Environmental Quality, or other legally binding standards.

4.1 MATERIAL CRITERIA

The minimum material criteria as outlined in the National Artificial Reef Plan are as follows:

Function

Selection of materials that are known to be effective in stimulating desired growth of organisms and providing habitat for the target species is critically important in developing artificial reefs. Proper design or configuration of selected materials on the reef site will contribute significantly to artificial reef function. Surface area, profile, shape, orientation, open (interstitial) spaces, rugosity and size are major design features that affect the function of artificial reefs and species that encounter those reefs.

Compatibility

To maximize fishing and fisheries benefits, artificial reef materials and selected designs should minimize environmental risks and user conflicts. While some risks and tradeoffs are inevitable, knowledge of a site's physical and biological characteristics and the possible uses of a reef can help planners design reefs that will avoid major problems. For example, reefs designed for divers should have materials that are attractive and minimize safety risks. Artificial reefs placed near natural reefs can be designed to ensure that materials will not encroach on the natural reef.

Stability

The movement of reef materials off reef sites not only violates permit requirements, but also can threaten navigation, foul commercial fishing grounds and litter beaches. This situation can be a significant threat to continued public support of artificial reef programs. All materials used in reef construction should be of proven stable design. In addition, the individual materials in composite structures should be stable on their own, since structures may break apart over time. The primary danger to unstable designs is that as structures break apart or shift, they may encroach upon and damage natural resources outside of the reef area. For example, the bond between concrete and steel in a certain structure may break, but it is unlikely that either material will be moved.

Durability

Artificial reef materials should be resistant to deterioration and breakup. Durable materials will retain the desired structure and configuration in the marine environment.

4.2 MATERIAL SUITABILITY

The disposal or availability of the material shall not be a driving force in material selection. The artificial reef development goals and objective should drive the need for appropriate artificial reef material. Materials of opportunity will be evaluated on a case by case basis and must adhere to the minimum material criteria, reef site permit requirements, be economically cheaper than natural sources, and feasible to deploy. Unproven material may require further analysis and monitoring after deployment.

Acceptable Material Examples:

- Natural shell from local sources or treated sources
- Natural rock;
- Clean concrete processed to reef site specifications
- Prefabricated modules constructed of concrete and/or thick gauged steel

Unacceptable Materials for artificial reef development include but are not limited to:

- All materials that can float
- All materials which contain or are coated with growth inhibitors (i.e. antifouling paint, antibacterial agents, etc.)
- All plastics, PVC or fiberglass
- Aircraft
- Asphalt
- Automobiles, buses, truck bodies, trailers or parts
- Cylindrical or spherical materials (round culverts, drums, pipe, etc.)
- Thin gauged metal objects (i.e. dumpsters, shopping carts, shelving units, desks, etc.)
- Tires
- Untested byproducts from combustion or manufacturing processes
- White goods (i.e. refrigerators, washers, dryers, toilet, etc.)
- Wiring and insulation
- Wood

A more detailed list of materials and their benefits/drawbacks can be found in the “Guidelines for Marine Artificial Reef Materials –Second Edition—January 2004” by the Gulf and Atlantic States Marine Fisheries Commissions. The book is a reference guide and does NOT constitute a list of approved artificial reef materials.

5.0 PERMITTING

The Louisiana Department of Wildlife and Fisheries (LDWF) through the Louisiana Artificial Reef Program is the applicant for all state and federal permits or authorizations required for the creation, enhancement, and maintenance of Louisiana’s artificial reefs in both state and federal waters. The state and federal agencies involved in the process vary based on the reef project. The process outlined illustrates the overall process and the key agencies typically involved.

A permit from the U.S. Army Corps of Engineers (USACE) serves as the primary certificate of approval for artificial reef development. In state waters, this regulatory responsibility is jointly carried out by both the Coastal Management Division (CMD) of the Louisiana Department of Natural Resources (DNR) and the USACE. The joint application is submitted to the CMD to be processed at the state level. The CMD handles the coordination with the appropriate state agencies (i.e. State Lands and Department of Environmental Quality) and issues a public notice. If the proposed project is consistent with the Program’s Coastal Zone Consistency and approved by the Louisiana Coastal Resources Program the CMD forwards the application to the USACE.

The USACE processes the permit application at the federal level and coordinates with applicable federal and state agencies. State authorization typically precedes federal approval in state waters. The USACE

reef building permit is primarily reviewed and granted under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403). For reef materials considered as fill, such as limestone, shell, and rubble, the reef project must also satisfy Section 404 of the Clean Water Act of 1972 (33 USC 1344). The Louisiana Department of Environmental Quality must provide a Water Quality Certificate for the reef project for the USACE to complete its Section 404 review. In addition to coordinating with the other government agencies, the USACE issues a public notice for review and comment.

Upon completion of the permitting process, the USACE will proffer a permit with stipulations based on assessments by state and federal agencies, along with consideration for comments made during the public notices. LDWF has the options to accept, appeal, or reject the terms and conditions of the proffered permit.

The Coast Guard exercises regulatory authority over artificial reef structures to ensure that obstructions in U.S. waters are properly marked for the protection of maritime navigation (43 U.S.C. 1333[e], 14 U.S.C. 81-87, and 33 CFR, parts 64-66). Once a USACE reef building permit is approved, the U.S. Coast Guard must be contacted to determine the marking requirements of the artificial reef upon construction. Marking requirements should be discussed with the USCG prior to the application process; however, the USCG will not provide the official marking requirements until the final USACE permit is issued. For those artificial reefs requiring navigational markers, a Private Aids to Navigation Application must be submitted to the USCG no later than 30 days prior to reef construction.

5.1 Proposals

The department greatly values its relationships with conservation partners and accepts proposals in the effort to build inshore reefs. Proposals shall, at minimum, include proposed reef location, justification, budget, and amount of match. In most cases a minimum 1:1 match of cash or in-kind/contributed goods and services is required. Higher match ratios increase the competitiveness of reef proposals.

5.2 Permit guidelines

Prior to commencement of accepted permitted activity, all contractors and sub-contractors will provide LDWF with the name of an individual in authority who can be contacted regarding any work done under the permit.

All vessels (i.e. rigs, tugs, barges, etc.) utilized under the permit shall be of such size, loaded and operated in such a manner as to not impact or otherwise disturb the water bottoms over which they pass and are limited to a draft of 6 feet or less fully loaded and under power.

All vessels utilized under the permit must be approved by LDWF prior to moving across the seed ground. All vessel specifications shall be provided to LDWF prior to approval of the vessel.

Movement of heavy equipment (i.e. rigs, tugs, barges, etc.) across the public oyster seed ground along the approved access route is only authorized at high tide or as close to high tide as practicable.

Contractors and sub-contractors shall secure approval of the access route from LDWF and shall ingress and egress to the project location only along the approved route.

Contractors and sub-contractors shall not discharge any produced waters nor discharge any human waste from any vessel that does not meet or exceed the requirements of the Department of Health and Hospitals.

The permit contractor and/or sub-contractors shall provide a letter of completion and certified surveyor's plat of the completed project to the Department no later than 60 days following completion of the permitted activity.

At the discretion of the Secretary or Assistant Secretary of the Louisiana Department of Wildlife and Fisheries, any activities may be suspended until more favorable conditions prevail.

6.0 MONITORING

Artificial reefs require monitoring to assure compliance with permit conditions and other applicable regulations, and to assess performance to confirm that the goals and objectives of the reef design are being achieved. The strategies for monitoring compliance and performance will depend on the degree of compliance and objectives required, and the resources available. Information obtained through monitoring can improve the management of existing reefs as well as the development of future reefs.

6.1 Compliance Monitoring

Defined in the National Artificial Reef Plan, compliance monitoring is conducted "to assure compliance with the conditions defined in any authorizing permits, or other applicable laws or regulations." Compliance monitoring may be conducted throughout artificial reef development and will depend on each reef permitted guidelines.

Pre-deployment Survey

Pre-deployment monitoring may include, but is not limited to, site assessments to examine bathymetry, characterize existing and surrounding habitat, substrate suitability, accessibility for deployment equipment and user access, proximity to navigable waterways, potential marking requirements, and potential user group conflicts. Suitable artificial reef material selected for the development will be inspected prior to deployment for adherence to reef specifications, permits, and agreements. Required notifications, deployment plans, and tow routes will be supplied within established time limits prior to reef material deployment activities.

Deployment monitoring

Reef materials must be transported to the deployment location without negatively impacting resources/habitat adjacent to the project area or in route. Accurate placement of reef materials should be achieved by developing a method for minimizing movement or allowing sufficient control of the vessel(s) utilized for transport and/or deployment. Machinery of sufficient capability should be used to ensure timely, effective and safe off-loading of reef materials per reef design specifications and permit requirements.

Reef materials must be deployed within the confines of the artificial reef boundaries per the reef design specifications and permit requirements. Temporarily marking the reef site prior to deployment may aid the deployment process. Marking of the deployment area should be performed by personnel qualified or trained in proper survey techniques.

Program staff or designees will monitor the deployment phase as necessary. Monitoring of the deployment will include all aspects of the operations: timeline of deployment progression, vessels and equipment used, personnel involved, any issues encountered, changes to deployment(s), GPS survey coordinates for individual deployments, depth/clearance information, and photos of material and deployment.

Post deployment Survey

Post-deployment monitoring will ensure permit requirements, including material location and clearance, have been met. Surveying shall be conducted with equipment and personnel capable of providing position and clearances within horizontal and vertical tolerances specified in authorizing permit and this plan. Properly applied techniques utilizing a differential geographic positioning system (DGPS) and a sonar system such as side scan, multi-beam, or sector scanning shall be used to provide the data necessary to confirm reef material deployment compliance. Non-standard survey methods to confirm position and/or clearance over reef must be approved by the Program. The post deployment survey shall be certified and stamped by a professional land surveyor.

To document any possible movement of artificial reefs from permitted areas, it is recommended that reefs within the immediate impact zone of a weather system meeting or exceeding tropical storm status be surveyed.

6.2 Performance/Assessment monitoring

Performance monitoring is not a requirement listed in most permits for artificial reef development. However, monitoring a reef's performance can provide valuable information to determine whether a reef is meeting the goals and objectives for which it was built. Monitoring the physical, biological, and socioeconomic aspects of a reef can inform future reef management and development. Therefore, one-third of the total developed inshore and nearshore reefs will be surveyed each year, with the goal of surveying all reefs every three years.

Physical

Physical monitoring of reefs should be done on a routine basis to ensure materials are not deteriorating and remain able to provide substantial habitat for a long period of time. Additionally, location and material depth should be monitored to reduce potential liability. These surveys require equipment such as depth recorder, SCUBA divers, or side scan sonar.

Biological

Changes in fish and invertebrate assemblages are expected at the location of artificial reef deployment. In order to document these changes caused by reef development, monitoring consisting of SCUBA diving, creel surveys, underwater video, trapping or netting, acoustic telemetry, or remote sensing is necessary. Other monitoring techniques and equipment may be used depending on the type of data and analysis required to evaluate biological effects. These assessments can be useful in planning future siting of artificial reefs, identifying research priorities, and detecting possible unpredicted negative consequences.

Socioeconomic

Prior to developing reefs, user groups are made aware of proposed reef plans and are able to voice concerns; however, feedback after deployment is also important. Evaluating the success of artificial reef development in a region allows insight to social and economic impact.

Surveying reef usage by anglers is an incomplete measure of socioeconomic effects. Over a decade of angler reports have been collected by the department and analyzed for reef landings. Department data will be supplemented with specifically directed surveys administered by the program. The Program will continue to produce outreach materials, including underwater videos, informational brochures, and an interactive website. Future monitoring may include volunteer tagging events at developed artificial reefsites across the state. These monitoring efforts along with increased public interaction will assist in identifying overall cost, construction, and maintenance effectiveness of artificial reef development.