

**History and Overview of the Osborne Reef  
Waste Tire Removal Project  
Updated August 8, 2016**

During the 1970s, between one and two million tires were placed in the ocean off Broward County as an artificial reef. The tires did not successfully create an artificial reef. Over the years, many of the tires were mobilized by tropical storms and hurricanes. The movement of these tires has caused damage to nearby existing coral reefs. A small tire retrieval program was conducted in 2001 by Dr. Robin Sherman of Nova Southeastern University, under a \$30,000 grant from the National Oceanic and Atmospheric Administration (NOAA). Approximately 1,600 tires were retrieved at a cost of over \$17.00/tire. Due to the magnitude of the project and the projected cost, the tires have not yet been abated.

The Department of Environmental Protection (DEP) was contacted by a Coastal America representative in 2006 and asked to work with them on a major project to remove the tires. Coastal America is a partnership of federal agencies tasked with the protection and restoration of our oceans and coasts. Coastal America organized a cooperative project with the US Navy, US Army, US Coast Guard, NOAA, Broward County Environmental Protection and Growth Management Department and DEP to abate this tire pile that is endangering the Broward County Osborne Reef.

The NOAA Marine Debris Program funded a reconnaissance project that was conducted in August, 2006. The scope of work for this project included the development of a strategy for removing and properly disposing of the tires. Retrieval techniques were explored; 30 sample tires were retrieved and examined for processing suitability. Handling, staging and transportation methods were considered; and end uses were explored. As there has not previously been a recovery of waste tires from the ocean of this scale, it was decided that a pilot program was needed in 2007 to test diver retrieval productivity, loading and transport methods, and tire processing and use.

The next steps included planning the complete removal of the waste tires and seeking funding for this effort. Complete removal required Federal funding for military diver salvage operations and watercraft, as well as State funding for processing and disposal of the recovered tires. Project management for the 2007 pilot was provided by Broward County and tire processing services were funded by DEP out of current year abatement funds. The Navy took the lead and organized the multiple military dive teams interested in recovering tires as a part of their annual training in 2007 and beyond.

Initially, the full abatement project was expected to last for portions of three years, depending on retrieval rates and the diving and watercraft units available each year. The extent of the funding required for full abatement was estimated to be about \$3.4 million in state and county funds. Funding estimates for military participation were not calculated as their participation falls within the Integrated Readiness Training (IRT) funded through the Department of Defense (DOD). The total cost per tire is estimated to be less than the \$17.00/tire associated with the 2001 study conducted by Nova Southeastern University; however, the cost to abate the pile still exceeded amounts in DEP's current waste tire abatement contracts. As a result, Governor Crist recommended and the Legislature passed a \$2 million special appropriation in 2007 for DEP to complete its share of the project.

## Pilot Program 2007

The pilot program began in June 2007, and ran for 20 days. The IRT program provided 40 military divers and one Landing Craft Utility (LCU) ship for the pilot. Broward County provided significant in-kind services that included all dockage and associated fees and all on-site management. The DEP provided funding for a tire processing contractor and for consumable supplies and equipment that the military could not provide.

The pilot project allowed projections based on a conservative assumption that military divers can remove 1000 passenger tire equivalents (PTEs)/day using 40 divers and 1 LCU. Resulting monthly tire removal was estimated at 20,000 PTEs (1000 PTEs/day x 5 days/wk x 4 wks/mo); a 3 month project would produce 60,000 PTEs; and a 4 month project would produce 80,000 PTEs. At this rate, complete cleanup of the estimated tires would take about eight years, since weather conditions and military asset availability limit work to about three to four months per year. Actual productivity could increase in future years and these projections would be revised accordingly.

It was decided that the priority areas needed to be redrawn to emphasize the importance of removing tires from the east face of the affected portion of the middle reef and adjacent areas of sand from which tires are likely to be transported to the middle reef face during storm events. In the revision, Priority Area 1 will be cleared in a south to north direction first. Priority Area 2, divided into five subareas, will be cleared beginning with Area 2a (south to north), 2b, etc. Priority Area 3 is relatively stable and shall only be cleared after Areas 1 and 2. The total area of Priority Area 1 and the revised Priority Area 2 are approximately 30 acres. Estimated combined tire quantity is 651,565 PTEs, presented in Table 1.

Table 1. Summary of estimated tire quantities to be removed in priority areas.

Priority Areas	Area (yd <sup>2</sup> )	Thickness (yards)	Volume (yd <sup>3</sup> )	Density (PTE/yd <sup>3</sup> )	Tire Quantity (PTE=passenger tire equivalent)	
					PTE	Tons
1	26,494	1.00	26,287	14.0	368,018	3680
2a	27,854	0.17	4653	15.0	69,797	698
2b	15,213	0.17	2586	15.0	38,790	388
2c	27,363	0.17	4652	15.0	69,780	698
2d	26,973	0.17	4585	15.0	68,775	688
2e	23,271	0.17	3956	15.0	59,340	593
TOTAL					651,565	6745

This number still exceeds the capabilities to remove all the tires in a three-year project, as was originally intended. In order to remove the tires from Priority Area 1 and revised Priority Area 2, an increase in military salvage resources should be made available within a 120-day project period in each of three years, beginning in 2009. These additional resources would be additional divers and watercraft for tire transport to shore.

## **2008 Operational Phase**

The first full phase of tire removal dive operations began in April 2008. Divers worked an estimated 27 days with 16 dive days cancelled due to adverse weather conditions.

An estimated 44,000 tires were removed over the course of the operation by approximately 66 military personnel, including boat drivers and LCU crew. When conditions were ideal (e.g. calm seas, no equipment failures), the divers were able to recover approximately 2,500 tires during a single day, using two open-top trailers on the LCU. This appears to be the maximum productivity that can be expected during the operation. The required time for the LCU to weigh anchors, return to Port Everglades, offload/reload trailers, and return to the dive site will prohibit more than one load (two trailers) being recovered in any given day.

## **2009 Operational Phase**

The second full phase of tire removal dive operations began in July 2009. Divers worked an estimated 16 whole or partial days with two dive days cancelled due to adverse weather conditions or equipment failures. An additional 11 days of mission operations were cancelled due to unscheduled mission assignments to support the NASA shuttle launch.

An estimated 15,000 to 18,000 tires were removed over the course of the operation by approximately 50 military personnel, including boat drivers and LCU crew. When conditions were ideal (e.g. calm seas, no equipment failures), the divers were able to recover approximately 2,000 tires during a single day, using two open-top trailers on the LCU.

## **2015 Operational Phase**

The third phase of tire removal dive operations resumed in May 2015 with use of a commercial salvage dive company. In this phase, divers are focused on removing tires from Priority Area 1. Divers have removed an estimated 67,000 tires over the course of the operation to date. As of August 2016, an estimated 207,843 tires have been removed from the Osborne Reef. Divers are currently removing tires from the reef under contract with DEP.