

# ***Possible environmental effects of the construction of a pier and its future usages near Karel's Bar, Bonaire***

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## ***Purpose***

This short report aims to overview the potential impacts on the marine environment associated with the construction and future use of a pier near Karel's Bar in the center of Kralendijk, Bonaire. Following the procedures outlined in the Maritime Law BES, an assessment is needed that overviews the effects on the marine environment caused by the construction of such pier, its presence and future use.

The placement of 36 pilings to support the pier had already started but was halted by local authorities. In addition to permits from local government agencies (e.g., the island resolution marine park Bonaire), a permit required under the Maritime Law BES had not been applied for. Stakeholders (e.g., DROB Bonaire, Rijkswaterstaat) proposed a solution to determine if placement of the pilings in the near future could still be allowed. This solution consists of a short study that (1) overviews the potential environmental impacts of the construction of the pier and all its future usages and (2) specifically addresses whether the placement of the pilings is detrimental to the marine environment. Should the effects of piling placement be minimal, the placement of the pilings could be allowed while additional studies are carried out to determine whether the entire project (i.e., the use of the pier as dive school/ (temporary) restaurant) has negative impacts on the marine environment. Should it be decided that the entire project does not or cannot confirm to applicable laws, it is possible that the pilings will have to be removed.

This report provides only a broad overview the expected impacts of the pier and its future usages and mainly focuses on the potential detrimental effects of the placement of the pilings on the nearby marine environment. A second report will focus in greater detail on (1) the potential impacts of the construction of the pier beyond the direct impacts of piling installation, and (2) the potential impacts of the pier and its use on the surrounding environment after construction has been completed. This assessment will therefore serve as a base for condition-stipulating recommendations for the construction, presence and use of the pier to prevent insurmountable harm to the marine environment.

### ***Description of the proposed action***

The proposed action consists of the placement of 36 iron pilings (76 cm in diameter, 2 cm thick and 6 m tall; specifications provided by Cashman Enterprises) on the shallow reef terrace directly west of Karel's Beach Bar, Bonaire. Pilings will be "vibrated" into the ocean bottom using a specially designed barge (IHCC) so that they extend approximately 1 m above the sea surface and their base lies at approximately 3 m below the reef surface. The pier will form a semicircle that connect the shore west of Karel's Bar to the existing pier of the same establishment, extending approximately 41 m from shore (as measured from the high-water line to the farthest offshore point of the pier). This report focuses on the effects of the construction of the aforementioned iron pilings on the surrounding marine environment. In addition, the potential environmental consequences of the finalization of the pier (e.g., pouring concrete frameworks, etc.) and the planned usages of the pier (i.e., dive-school and a (temporary) restaurant/ bar) are briefly overviewed in this document, but will be discussed in detail in a future report.

### ***Project Setting***

The construction activities are proposed directly west of the existing facilities of Karel's Bar. The coast is heavily developed, primarily by tourism-related infrastructure. The pier is planned at a location where the reef bottom mainly consists of a sandy rubble field extending out to the reef drop-off at approximately 8-10 m depth where the reef slopes down to greater depths. On the deeper part of the reef flat and on the reef slope, rubble, i.e., dead pieces of coral, also cover most of the bottom. No benthic communities consisting of corals, sponges, etc. are expected at this location. Excess sedimentation in the past from construction activities, continuous terrestrial run-off (e.g., subterranean sewage fluxes, storm water, etc.), accidental dumping of (wind-blown) debris and trash, anchoring, as well as several storms (e.g., Tropical Storm Omar, Hurricane Lenny) are likely responsible for the fact that the area around the constructed pier is largely devoid of marine life. Therefore, the general area can be characterized as heavily degraded.

### ***Project Concerns***

Main concerns regarding the pier construction are (1) the potential damage to or irreversible loss of marine life, archaeological sites or artifacts, and (2) its potential danger to maritime operations in the area.

### ***Physical and environmental Impacts: Placement of the pilings using a vibratory pile driver rig***

These impacts are expected to be minimal. The pilings themselves will be placed in a heavily degraded area using the approach described above. During the construction phase, two aspects should be considered: (1) placement of the anchors of the barge that holds the vibratory pile driver and (2) the potential negative effects of the sound produced during pile driving on fish and coral larvae. Given the degraded nature of the area in which the construction of the pier is planned, anchorage by the barge is not expected to result in significant damage. It is however advisable to carefully determine drop sites before anchor placement to ensure that scattered coral communities that could locally still be present in the area are not unnecessarily damaged. An unattenuated pile strike will produce a sound pressure level around 180 dB RMS at a distance of 200–300 meters (California Department of Transportation 2009). To compare: large tankers and naval vessels produce up to 198 dB, depth sounders can produce up to 180 dB and even small boats with large outboard motors can produce sound pressure levels in excess of 175 dB (WSDOT 2006). Exposure to low levels of sound for a relatively long period of time, or exposure to

higher levels of sound for shorter periods of time, may result in auditory tissue damage in fish, though recovery is generally possible within 24 hrs (Popper et al. 2005). Compared to data for the effects of exposure to sound on fish hearing capabilities and the ear, there are even fewer peer-reviewed data regarding effects on other aspects of fish anatomy and physiology, though oscillations induced by high sound pressure levels can cause swim bladders in fishes to tear or rupture (Hastings and Popper 2005). Whereas it is possible that some (although not all) species of fish would swim away from a sound source, thereby decreasing exposure to sound, larvae and eggs of fish (and also corals) are often at the mercy of currents or move very slowly. Effects of pile driving of pilings that were 4 m in diameter on fish larvae were recently tested at a 100 m distance, but no lethal effects were found (Bolle et al. in prep.). Data are limited concerning the effects of sound on developing eggs and larvae for nearly all marine taxa and effects differ enormously among species (Banner and Hyatt 1973). In conclusion, because sound plays a role in the ecology and physiology of various marine taxa (e.g., Simpson et al. 2004; Simpson et al. 2005; Vermeij et al. 2010), the disruption of the native sound spectrum in an area may have an impact on local marine communities. However, given the relative short duration of the project as well the fact that the activities take place in an area characterized by heavy boat traffic which is likely to result in similar if not more “sound pollution”, it is expected that the negative effects of piling placement using a vibratory pile driver on local marine life will be marginal, if not negligible. Main reasons to support this expectation are (1) the area in which activities take place is already heavily degraded and (2) the potentially negative effects of the sound produced while driving the piles is comparable to the area’s existing sound environment which has been disturbed due to the many boating activities in the area (including nearby recreational and fishing harbors, waterskiing, general boat traffic, the presence of a nearby cruise boat terminal and a commercial harbor).

***Physical and environmental impacts: Construction of the pier beyond the placement of the pilings and its planned usages***

As stated before, details on the potentially negative impacts of the construction of the pier beyond the placement of the pilings as well as potential impacts of its future use are beyond the scope of this report. However, a general overview of aspects related to these activities is listed below.

***1. Construction of the pier’s concrete support system***

Any construction at or near the water edge, or where debris can be washed or blown into the water, should be surrounded by silt screens, which must be placed in the water before the work starts. The screens should also be placed around storage areas, to prevent waste from blowing away and to prevent sediment run-off into the sea. In addition to silt screens, building guidelines of the Bonaire National Marine Park require that storage areas for sand and soil, *and* all work areas, must be at least 20 meters away from the high water mark and construction equipment must not be cleaned or washed within 50 meters of the high water mark. Cement used to make concrete can be carried to nearby reefs with local currents. Because cement raises the pH of the surrounding seawater considerably (Stark 1955), cement used to construct the proposed pier has the potential to affect the relatively well-developed coral communities that exist < 1 km down-current of the construction site.

## *2. Structural integrity of the proposed infrastructure during severe weather events*

Experiences from both Bonaire and Curacao have shown that facilities located on piers are generally too weak to withstand occasional severe weather events. In the recent past, tropical storms Lenny (1998) and Omar (2008) destroyed a significant number of piers and nearshore facilities on both islands. While it is presently unclear whether the proposed facilities are designed to withstand such storms, this matter deserves critical attention. Destruction of all or part of the proposed facilities by a storm will cause a large flux of debris to nearby marine and coastal environments. Such concerns go beyond structural aspects and also include precautionary measures to protect waste water systems etc. from being damaged during such events.

## *3. Disposal of sewage and waste generated by restaurant*

The future usages of the pier include the following: a dive school, a bar/restaurant and presently unknown functions related to the planned inclusion of the proposed pier and associated facilities in a hotel-complex that is planned for construction on a nearby site. Given the variety of usages associated with the pier and the large number of persons expected to participate in these activities (the facility can seat at least a 100 persons), disposal of sewage and waste (generated by customers and the restaurant/bar facilities) deserve the utmost attention to prevent these materials from entering the nearby reef waters. Disposal of liquid waste (with sewage being the major concern), should occur by connecting the facilities to the Bonaire waste water system. Any type of liquid waste (including sewage, water used for washing, particulates, organic waste, chemical/ cleaning products) is extremely detrimental to tropical marine communities and can easily affect marine ecosystems downstream of the construction site (where relatively healthy coral communities are found) as waste easily travels with local currents. It is therefore of paramount importance that all waste generated by the proposed facility (in the broadest sense of the word) does under no circumstances enter the surrounding waters. Furthermore, many people using the bar/ restaurant facilities on the pier will cause a large flux of waste (i.e., napkins, plastic cups etc.) into the ocean as the wind will blow such items from the pier. It is presently unclear how the proposed facilities aim to address this concern. Lastly, since the pier will (at least in part) serve as a bar/ restaurant, regular cleaning will be required as demanded by local health authorities. Cleaning such a large pier, which is to some degree largely open structure that facilitates the leaching of chemicals, will cause the input of cleaning products as well as nutrients (e.g. phosphates), to the water. Again, it is presently unclear how such compounds will be prevented from entering the water.

## *4. Beach construction*

East of the proposed dive school/bar/ restaurant a small beach is planned. It is currently unclear whether it is expected that such beach forms naturally or whether it will be created artificially. In case of the latter, it needs to be noted that artificial beach creation has generally been unsuccessful in the region and generally results in excessive sedimentation on nearby reefs. This aspect of the proposed activity needs additional clarifications before its potential negative impacts can be assessed.

## *5. Boating and navigational issues*

The planned pier will be connected to an existing pier that has existed > 15 yrs and therefore results in minimal changes in the seascape as relevant to boaters.

## 6. Archaeological aspects

None. The area has been intensively used in the past. Nearshore development and former anchorage by boats have modified the environment to such degree that historic artefacts are longer expected to be present.

## Conclusions

This document should be viewed as an expert judgement that evaluates current knowledge given a very short period of time for this advice. The proposed placement of the proposed 36 pilings is unlikely to result in insurmountable damage to the marine environment and organisms living therein. A future report is required to assess the consequences of the additional building activities required to finish the pier and the consequences of its future usages. This report will be provided after the site is visited on October 24<sup>th</sup> 2011 and additional details have been obtained on the future activities that will take place on or near the pier.

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