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Albany Artificial Surf Reef Project - Detailed Design Report

Report for C19023

Report #: P19024_DetailedDesign_R2.00.docx

2 September 2020

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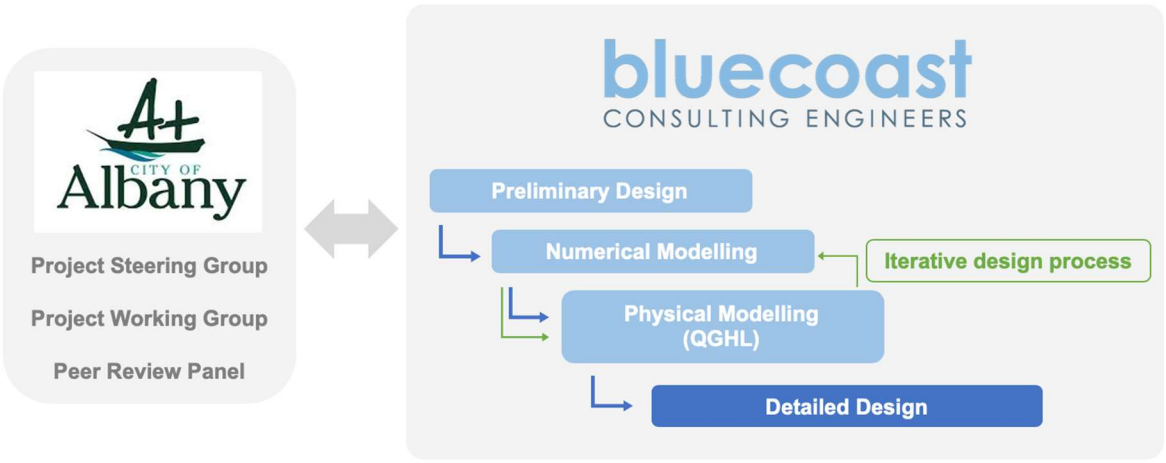
Document history

Version	Date	Author(s)	Reviewer(s)	Status	Signature
1.00	30-Jul-20	E. Watterson, H. Loehr, J. Lewis and T. Van Loon	E. Watterson	75% DRAFT	 E. Watterson
2.00	2-Sep-20	E. Watterson, H. Loehr, J. Lewis and T. Van Loon	E. Watterson	90% DRAFT	 E. Watterson

Title page photo: Artist impression of Albany Artifical Surfing Reef (source: City of Albany)

Readers Note

This Detailed Design Report is the final report in a series of reports that have been delivered for the Detailed Design phase of the Albany Artificial Surf Reef (ASR) project. The report summarises the key details of the preferred design solution, its validation and implementation. An iterative process was followed to develop the design using both numerical and physical modelling tools. Each of the applied tools have limitations but when combined they provide a robust assessment method. The figure below provides an overview of the iterative design process undertaken in reaching the detailed design phase.



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Executive Summary

This report sets out the detailed design of an artificial surf reef (ASR) for Middleton Beach in Albany, Western Australia. Opportunities for surfing are highly limited in the region, and the construction of an ASR will make the most of the unique wave and tidal climate and greatly enhance the local surfing amenity. Improvements in surf amenity are intended to meet broader community objectives relating to tourism and economic development within the region. Design of the ASR has been carried out in consultation with the City of Albany, with due consideration to the coastal management procedures already in place.

The proposed ASR consists of a submerged rock reef structure, the design of which has resulted from an iterative process involving thorough numerical, physical and conceptual modelling. All aspects of the ASR design were considered in modelling, including its location, footprint and shape. The location has been optimised based on existing seabed variability, user accessibility, shoreline response, wave climate and local ecology. The shape has been optimised to improve wave breaking characteristics, promote user safety, minimise coastal impacts and reduce construction costs.

The optimised ASR provides a ‘left-hander’ surfing wave, situated 150m north of the ‘Surfers Beach’ car park and approximately 145m offshore. The reef measures 165m long and varies in width up to 100m. At its shallowest point, the crest of the ASR will be 1m below average water level to maximise wave breaking whilst also ensuring adequate user safety. It will feature a kinked crest toward the landward end of the structure to maintain the peel angles of breaking waves in the target range for beginner and intermediate surfers. Small wave heights are amplified along the length of the structure crest to provide surfable waves in marginal conditions and increase the number of waves breaking per minute. The design provides surfing rides of up to 100m during average conditions with surfable waves expected for 41 per cent of the year over the ASR with further increase in surfing opportunities inshore of the structure. This is considered a large improvement as currently surfable waves in this location occur only a handful of times a year.

The investigations undertaken in the preparation of this report have taken place according to a ‘multiple lines of evidence’ approach. Foundationally, targeted field investigations were used to obtain a complete picture of the metocean, environmental and geophysical context of the proposed site. These investigations complimented longer term historical datasets collected as part of the City’s Coastal Monitoring Program as well as Southern Ports Albany (SPA) and Department of Transport (DoT) operations.

Numerical modelling was used to predict the response to and optimise the design of the ASR. Firstly, simulations of wave and hydrodynamic processes over and in the lee of the ASR allowed for the enhancement of surfing amenity. Secondly, the models helped to predict short-term changes to nearshore currents as well as longer-term changes across the entire embayment. Finally, modelling of cross-shore and long-shore currents aided in understanding potential effects of the ASR on sediment transport.

Scaled physical modelling tests were also used in the investigation in an iterative feedback with the numerical modelling. Stability of the structure was a key outcome of these tests, informing rock sizing selection in the design of the ASR. Analysis of video captured during the tests using wave pocket tracking technology indicated that waves broke at desirable speeds over sufficient length and presented breaking intensity and wave face shape that was suitable for beginner and intermediate surfers. Dye deployments and sand tracer testing were used to illustrate the effects of the ASR on the flow regimes and potential sediment transport in its vicinity.

The final line of evidence comprised a quantified conceptual coastal processes model. Based on the review and synthesis of all relevant site observations and data, a justifiable hypothesis of the coastal processes at play along Middleton Beach was presented. The evidence indicated that Middleton Beach has a positive sand budget, a stable shoreline, and a sufficient storm buffer, providing an ideal context for the placement of an ASR.

Based on the multiple lines of evidence approach, a clear picture of the project's predicted performance is obtained and evaluated against Key Performance Indicators (KPIs). With surfing amenity given the highest priority, the other key success factors examined relate to shoreline variation, environment, cost and safety. Modelling suggests that the ASR satisfies all KPIs, with the exception of capital cost, expected to be refined during the competitive tender process.

The Target Outturn Cost (TOC), which is the target cost estimate to deliver the project, has been estimated as $9.5 million. While the cost estimates exceed the initial (feasibility stage) estimate by 5.5%, considerable value engineering has been undertaken to reduce the construction costs (e.g. introducing a sand belly, single armour layer etc.) to affordable levels.

Constructability of the ASR has been a key consideration in the design process with informal contractor involvement and quarry investigations being undertaken based on a key design recommendation for the ASR to be constructed from rock and within one season. Building on knowledge gained from the recent construction of a rock reef at Palm Beach on the Gold Coast and with local and international contractor input, several construction methodologies were assessed that were suitable to build the designed ASR to within specified tolerances.

The recommended model for project implementation is a collaborative contract between the Principal, the Contractors and other key stakeholders which will facilitate optimal risk sharing. Separating the contracts for rock sourcing and construction of the ASR is advised to aid in the staging of works, as well as to help retain money in the regional economy.

The external approval process has also been continued and it is envisaged that there will be no foreseeable extended project hold points following the initial notice of decision and public advice provided by the Environmental Protection Authority (EPA).

Whilst $4.5 million has been pledged by the State government for the project, funding to cover the remainder of the updated project implementation costs is yet to be realised. The multiple lines of evidence presented in this report provides weight to the business case for the ASR, coupled with previous project success, there is strong justification for a favourable investment decision in the Albany Artificial Surf Reef.