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ASR America Response to the Brevard County

Multi-Purpose Artificial Surfing Reef Feasibility Study: Final Report

Executive Summary

ASR America does not endorse many of the findings presented in the Brevard County Multi-Purpose Artificial Surfing Reef Feasibility Study Final Report. Our major objections are summarized below.

- The statement, " *There remains uncertainty as to the predictability of the extent to which ASRs affect erosion of adjacent beaches,*" is not supported by the available data and peer reviewed publications.
- Large wave events produce rip currents all along the coast of Brevard County. This report is misleading in that it suggests that the reef would create the rip currents.
- This report states, " *To serve as hardbottom mitigation in Brevard County, an ASR would need to be comprised of limestone boulders or limestone embedded in concrete*". This statement is not supported by CSA International's findings.
- The erosion control benefits presented in this report are based on very narrow criteria which underestimate the erosion control benefits of the reef.
- This report does not take into account the damage prevention benefits of the salient which will form in the lee of the reef.
- This report grossly underestimates the surfing enhancement potential of the reef.
- The economic impact assessment grossly underestimates the recreational and surfing event benefits of the reef.
- The economic impact assessment does not include any provisions for marketing, public relations, fishing, diving, or other factors typically included in economic impact assessments of this nature.
- The Benefit to Cost ratios presented in this report are based on very narrow erosion control benefit criteria and unreasonably low recreational and event benefit calculations. ASR America does not agree with the figures presented in this report.
- ASR America does not agree with the conclusions regarding economic justification for Federal and State cost-sharing presented in this report.

ASR America has performed an independent Benefit to Cost analysis which incorporates all the objections noted above. The results for various scenarios are presented in the table below. We consider these estimates to be very conservative as they do not include any provisions for marketing, public relations, fishing, diving, or other factors typically included in economic impact assessments of this nature.

Scenario	Benefit to Cost Ratio
Coastal protection benefits only. No recreation or surf event benefits.	1.30
Coastal Protection and recreation benefits. No surf event benefits.	2.38
Recreation and surf event benefits. No coastal protection benefits.	2.71
Coastal protection, recreation, and surf event benefits.	4.00

Based on the results presented above a Multi-Purpose Artificial Surfing Reef in Brevard County would be economically justified and qualify for Federal and State cost-sharing.

***ASR Limited and ASR America are the only firms in the world currently designing and building Multi-Purpose Artificial Surfing Reefs. Should Brevard County decide to build a reef, ASR America will bid for the design and construction contracts.**

This response will only address those findings which have been included in the Executive Summary of the final report. Please refer to the ASRA response dated October 31, 2008 for a more detailed response to specific items in the body of the report. A complete list of all references cited may be found at the end of this report.

MPASRs affect on erosion:

"-There remains uncertainty as to the predictability of the extent to which ASRs affect erosion of adjacent beaches. Even after over 8 years of monitoring of the Narrowneck Reef in Australia, the extent to which the Narrowneck reef may have reduced erosion of the adjacent beaches has not been quantified – in part due to insufficient shoreline data for the period prior to construction of the Narrowneck reef."

With respect to predictability, we assume this means being able to assess the extent of salient formation due to the offshore structure, and again we refer you to the variety of peer-reviewed and data-supported references and explanations provided in our response dated October 31, 2008.

With respect to the predictability of the Narrowneck reef salient response, we again refer you to the numerical modeling (Black K.P., 1998c), which was supported by the physical modeling, which is supported by the monitoring data (Jackson et al., 2007). In addition to the data and publications, the large salient at Narrowneck is evident in countless images from the ARGUS monitoring system (WRL, 2008/06).

Over eight years of monitoring the shoreline response to the Narrowneck Reef, performed by the Water Research Laboratory (WRL) at the University of New South Wales in Australia, has shown the clear formation of a salient in the lee of the structure. This is shown in Figure 1 below which was modified from Figure 7.1 of the WRL report (WRL, 2008/06).

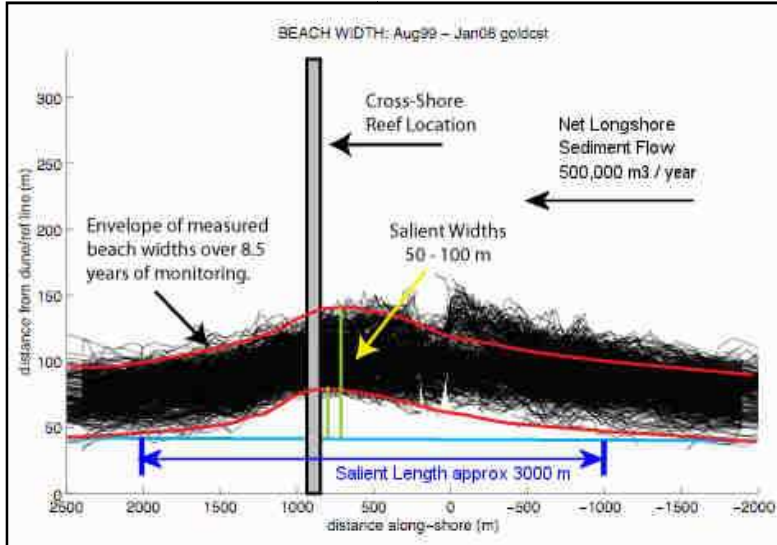


Figure 1. Salient Formation in lee of the Narrowneck Reef

Figure 1 clearly shows that an asymmetric salient with a varying cross shore width of 50m to 100m and an alongshore length of approximately 3000m has formed behind the Narrowneck Reef. These results compare favorably to the initial design predictions (78m cross shore, asymmetric to south) from Black (1998c).

The as built parameters for the Narrowneck Reef are a alongshore width of 150m, a cross shore width of 300m, and an offshore position of 225m. (WRL, 2008/06, Figure 3.6). Using the empirical methods developed by Black and Andrews (2001a), a salient with dimensions of 98m cross shore and 675m-933m alongshore is predicted. The actual salient, shown in Figure 1 above, is wider alongshore and roughly equivalent cross shore to the empirical predictions.

Figure 2 shows the comparison of current shoreline trends to the background trends prior to the Narrowneck project. The average rate of shoreline recession prior to the current project (background erosion) was -5 meters per year. The current shoreline trends indicate that erosion in the vicinity of the reef has been reduced well below the background rate. This section of beach had been nourished on average every ten years since the 70's. The last nourishment was done in 1987 (prior to 1999 project).

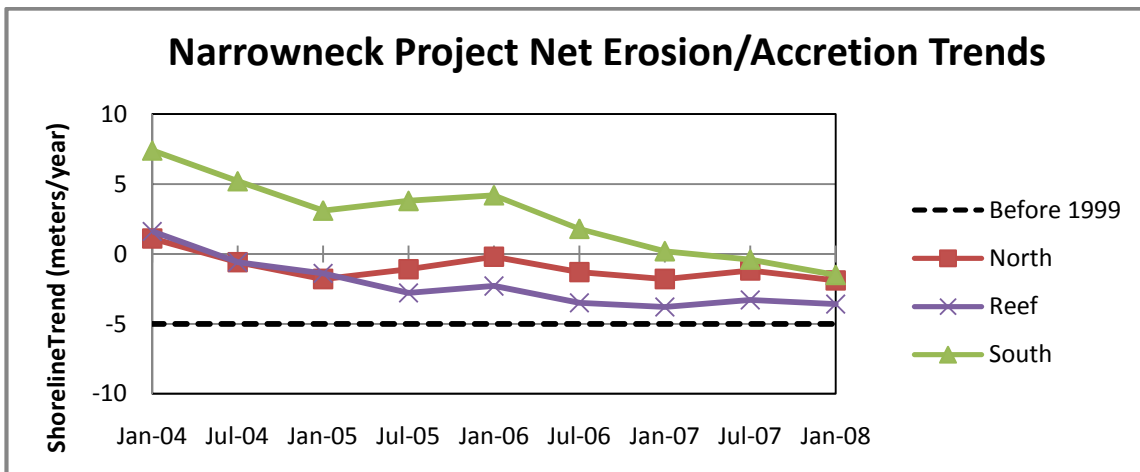


Figure 2. Narrowneck Project Net Erosion/Accretion Trends (WRL, 2008/06, Tables 7.1 and 8.1) (McGrath, 2008)

According to John McGrath, Engineer for the Gold Coast City Council (McGrath, 2008):

The beach in the lee of the reef was purposely over-nourished in 1999-2000 (more so than the other sections of the project) with the understanding that the erosion rates would be higher at that location as the beach system moved towards dynamic equilibrium. In other words they expected higher erosion rates behind the reef and they expect that to continue until the dynamic equilibrium has been achieved. The south reach experienced accretion for the first 6 years as the salient moved towards equilibrium. Now that the south reach has achieved relative equilibrium the excess sediment is moving northward resulting in the slightly erosional trend of the last two years (-1.5m/yr). They expect the erosion trends to equalize along the project shoreline once the entire system has reached equilibrium. In his opinion, the reef has significantly stabilized the nourishment project and reduced the total rate of beach recession rate along the entire project. They do not plan any further nourishment projects for this section of shoreline until 2032. The Narrowneck Project has extended their nourishment cycle well beyond the 10 year cycle they experienced before the reef.

The obvious trend in table 7.1 of the WRL report is that the nourishment along this section of coast moved to the north as expected with 500,000 m³ net northerly transport per year. The reef acts as a control point and through time the accumulation of sand reduces as the salient reaches equilibrium. The detailed numerical modeling of sediment transport predicted an asymmetric salient to the south of the reef due to the northerly sediment transport (Black, 1998c), that would stretch several kilometers to the south. As the southern area approaches dynamic equilibrium the erosion/accretion rates to the south will match those to the north. The effects of widening the beach in the area of the offshore reef and to the south are obvious in the ARGUS photo's.

All the available data and peer-reviewed publications confirm that a salient has formed in the lee of the Narrowneck Reef, that erosion has been reduced along the entire project, and that the nourishment cycle has been extended beyond the 10 year cycle that existed before the reef project.

Rip Currents:

"The ASR will produce rip currents during large wave events that pose a risk to swimmers and surfers."

Large wave events produce rip currents all along the coast of Brevard County. This statement is misleading in that it suggests that the MPASR would create rip currents. Most surfers will utilize rip currents to help them get out into the line up during large wave events. The risk is primarily to swimmers unfamiliar with ocean waves. Jackson et al, (2005) relate that the Gold Coast life-guards recorded 60% less rescues at the Narrowneck surfing reef that on other parts of the coast, despite its popularity.

Life Guards:

*To reasonably provide for public safety, it is expected that the County will need to:
_ Provide a year-round lifeguard and tower at an estimated cost of approximately \$75,000/year.*

The County recently authorized a significant expansion of the lifeguard stations for the beaches of Brevard County, including sites adjacent to the proposed reef site. This action was totally independent of the proposed reef. The proposed reef site may be moved based on the results of this report and further design studies. It is not evident at this point that an additional life guard station would be required specifically for the reef.

Mitigation:

To serve as hardbottom mitigation in Brevard County, an ASR would need to be comprised of limestone boulders or limestone embedded in concrete.

This statement is not supported by the environmental assessment prepared by CSA in Section 7 of the feasibility report :

7.2.5.3. Mitigation Potential

Because Geotextile containers filled with sand will support algae and fishes they may be suitable in part as mitigation for hard bottom impacts. As mentioned in Section 7.2.2.3 for limestone boulders, these structures could be incorporated into UMAM calculations to garner credit for some portion of the mitigation acreage.

Best Case Scenario Assumptions:

_ ASR maintenance will not be required.

ASR America recognizes that some maintenance of the reef may be required due to damage inflicted by human interaction and extreme weather events. The geotextile containers, however, have proven to be very stable in all conditions and resilient to human interaction.

Best Case Scenario Assumptions:

Beach fill maintenance requirements will be reduced by about 17,000cy per year.

The background erosion rate for the north reach of the Brevard County nourishment project is 190,000 cy/yr based on data presented in the 1996 USACE report (USACE, 1996). The north reach is 9.4 miles long which equates to a average background erosion rate of -3.89 cy/ft/yr. The average erosion rate at the proposed reef site is -11.4 cy/ft/yr based on data presented in Figure 3.2a of the feasibility report. All the available data and peer-reviewed publications confirm that a salient has formed in the lee of the Narrowneck Reef and that erosion along the entire project has been reduced below the original background rate. It is therefore logical and conservative to assume that the erosion rates adjacent to the Brevard County reef will be less than or equal to the original background rate of -3.89 cy/ft/yr. Using these figures the estimated reduction in erosion rate adjacent to the Brevard County reef will be:

$$-3.89 \text{ cy/ft/yr} - (-11.4 \text{ cy/ft/yr}) = +7.51 \text{ cy/ft/yr}$$

The reduced fill requirement of the reef protected zone will be:

$$7.51 \text{ cy/ft/yr} \times 2625 \text{ ft (salient width)} = 19,714 \text{ cy/yr}$$

This value was utilized in our Benefit:Cost ratio calculations presented below.

Best Case Scenario Assumptions:

Surfing Events will not likely occur due to the distance (1000± feet) of the reef from the beach, and the inability to view surfing action on an ASR from the beach.

It was ASRA's impression that the purpose of the economic report was to assess the economic impact of the proposed MPASR in relation to its ability to generate revenue as a surfing enhancement venue, independent of the coastal protection benefits. The point being that if the State and County would not or could not fund the reef on the basis of coastal protection benefits alone that the County may decide to build the reef for purely economic reasons much like the communities of Mount Maunganui, Opunake, and Boscombe. The economic study should therefore base its assumptions on the premise that the reef would be designed to optimize surfing enhancement rather than coastal protection. PEFS has based their report on the conceptual design developed by ASRA that was intended to maximize the coastal protection benefits of the reef. Consequently there are many negative remarks relating to the offshore position of the reef (300 meters). A reef designed purely for surfing enhancement could be smaller, less expensive, and positioned much closer to shore to enhance viewing opportunities and make it more accessible to less experienced surfers. In fact we could design several smaller surfing enhancement reefs for the same price as one large coastal protection reef. This would significantly increase the total number of surf visit days, thereby generating significantly more revenue.

Best Case Scenario Assumptions:

_ An ASR will significantly improve surfing conditions – sufficient to lure additional visitors to Brevard County – on average about 34 days per year.

The assertion, based upon local knowledge instead of data, that the reef will only produce improved surf conditions 34 days a year is not an accurate assessment of the surfing enhancement possibilities of the MPASR. According to the SES report:

The efficacy of the ASR in creating enhanced surfing conditions at R-18 can be crudely assessed in the following manner. Firstly, it is assumed that any wave that breaks on the ASR will be surfable, and will in fact provide a better break than would naturally occur at the site. Secondly, linear wave theory is used to transform each wave condition in the SWR from the archive point (10.6m mean depth) to its respective point of incipient breaking, i.e. representing shoaling & refraction, and assuming $H_b = 0.78 h_b$. Predicted astronomical tides are included in these computations. If the incipient breaking depth is less than the design-crest elevation of the ASR (-1.52m MHW), it is assumed that the waves will not break on the ASR. Figure 16 presents a histogram of the parameter defined as the difference between the depth at breaking and the depth on the crest of the ASR (negative values are lumped into the first bin of the histogram). Based upon this approach, waves would be expected to at least 'trip' on the ASR approximately 56% of the time. However, it is noted that tripping does not necessarily constitute an improvement in surf quality, nor in frequency-of-occurrence, as compared to the natural surfbreak at R-18.

ASRA agrees that the most significant improvement in surfing will occur during long period swells and higher wave heights. Anybody who surfs knows that longer period swells produce the best surfing conditions – scientifically, this is because of increased energy in the wave. What SES and CTC have not taken into account is the increase in breaking wave height and intensity that will occur over the reef due to wave focusing and the significantly increased bottom gradient of the reef with respect to the natural seabed. These phenomena are explored in great detail by Mead and Black (2001a and 2001b) and Mead (2003).

According to SES, "Firstly, it is assumed that any wave that breaks on the ASR will be surfable, and will in fact provide a better break than would naturally occur at the site". ASRA agrees with this assumption. According to the SES report, waves will break on the reef 56% of the time or 204 days per year. While it is understood that not all of those 204 days will be good surfing days, based on our local knowledge, if there are waves breaking on the reef, surfers will surf them.

Another factor to consider is that both the Narrowneck reef and the Mount reef result in adjacent sand banks that are conducive to surfing. Additionally, numerical modeling performed by ASRA, predicted that when the combination of wave height and tide level does not support wave breaking on the reef the reef will act as a wave focus creating an A-frame peak at the shoreline with higher wave heights than the adjacent shoreline (Appendix C3, page 11, Figures 4.2 and 4.3).

ASRA's conceptual reef design is a preliminary design which focused on the coastal protection benefits of the proposed reef. The major reef parameters, size, volume, elevation, location and shape were established to provide a basis for preliminary evaluation of the reef's ability to provide wave sheltering and wave rotation, two key aspects of coastal protection, as well as some rough gage of surfing enhancement. This preliminary reef design has not been optimized for surfing enhancement as that process requires numerical and physical modeling well beyond the scope of this feasibility study. Attempts by SES to critically evaluate the surfability of this design are premature. The final reef design will be refined to maximize the surfing enhancement for the local wave climate during the detailed design phase of this project.



Benefit to Cost Analysis:

The Benefit to Cost ratios presented by Coastal Tech are based on very narrow erosion control benefit definitions and unreasonably low recreational and event benefit calculations. We will discuss the methods used by CTC and PEFS in greater detail below. We will also present our own set of B/C ratio calculations.

Reef Costs:

The reef costs calculated by ASR America agree with the costs presented by Coastal Tech. We do not believe that the lifeguard tower expenses should be included in this analysis but we have left them in for comparison purposes. The reef costs are presented in Table 1.

Reef Costs						Inflation %	4.0%
20%							
Year	Design	construction	Life Guard	Maintenance	Monitoring	Annual Cost	
1	2009	460,000					460,000
2	2010		5,650,000				5,650,000
3	2011		\$ 75,000		175,000		250,000
4	2012		\$ 78,000		175,000		253,000
5	2013		\$ 81,120		175,000		256,120
6	2014		\$ 84,365				84,365
7	2015		\$ 87,739	282,500			370,239
8	2016		\$ 91,249				91,249
9	2017		\$ 94,899				94,899
10	2018		\$ 98,695				98,695
11	2019		\$ 102,643				102,643
12	2020		\$ 106,748	282,500			389,248
13	2021		\$ 111,018				111,018
14	2022		\$ 115,459				115,459
15	2023		\$ 120,077				120,077
16	2024		\$ 124,881				124,881
17	2025		\$ 129,876	282,500			412,376
18	2026		\$ 135,071				135,071
19	2027		\$ 140,474				140,474
20	2028		\$ 146,093				146,093
21	2029		\$ 151,936				151,936
22	2030		\$ 158,014	282,500			440,514
23	2031		\$ 164,334				164,334
24	2032		\$ 170,908				170,908
25	2033		\$ 177,744				177,744
26	2034		\$ 184,854				184,854
27	2035		\$ 192,248				192,248
Sum Total of Future Cost						\$	10,888,443
Interest Rate							4.0%
Net Present Value of Future Cost (Discounted)						\$	8,437,277
Annual Cost						\$	540,087

Table 1. Reef Costs

Shoreline Protection Benefits

Coastal Tech has defined the erosion control benefits of the reef as being limited to the amount of reduced fill required as a result of the reef and its associated salient. While the reduced fill is certainly an important component of the erosion benefits there are other factors which should be considered. If the current Federal Shore Protection Project for Brevard County was judged using the same criteria the B/C ratio would be zero, since all the sediment placed on the beach will eventually erode away. The USACE defines the primary benefits of the Brevard County nourishment project as the prevention of damage to upland structures, coastal armour, backfill, and loss of land (USACE,1996). The nourishment project provides these benefits by creating a wider beach which acts as a buffer against background erosion and storm events. The reef will also create and maintain a wider beach through salient formation. The wider beach created by the salient will provide an extra layer of protection to a section of the beach which would otherwise be more vulnerable since it was an erosion hot-spot. Therefore the added damage prevention resulting from the reef salient should be included in the calculation of erosion benefits.

The Federal Shore Protection Project for Brevard County estimated the damage prevention benefits for the north reach to be \$3,132,000 in 1996 dollars. In Table 2 that figure has been adjusted for inflation and the net present value of the damage prevention benefits for a salient 2625 ft long has been calculated over the 25 year life of the reef project. The annual damage prevention benefits were then calculated to be \$406,026. This damage prevention benefit should be added to the reduced fill benefit when calculating the total shoreline protection benefits of the reef.

ASR America has re-calculated the erosion benefits (reduced fill) using the the reduced fill requirement of 19,714 cy/yr (described earlier). The result is a net present value of erosion benefits of \$4,587,296 over the 25 year life of the project (Table 3). The annual erosion benefit is \$293,642.



Salient Damage Prevention Benefits - Based on USACE 1996 Report				
Inflation Rate		4%		
Year	Annual Benefit		Benefit per ft	Annual Benefit of
	North Reach		(9.4 miles)	2625 ft Salient
	1996	\$ 3,132,000		
	1997	\$ 3,257,280		
	1998	\$ 3,387,571		
	1999	\$ 3,523,074		
	2000	\$ 3,663,997		
	2001	\$ 3,810,557		
	2002	\$ 3,962,979		
	2003	\$ 4,121,498		
	2004	\$ 4,286,358		
	2005	\$ 4,457,813		
	2006	\$ 4,636,125		
	2007	\$ 4,821,570		
	2008	\$ 5,014,433		
1	2009	\$ 5,215,010	\$ -	\$ -
2	2010	\$ 5,423,611	\$ -	\$ -
3	2011	\$ 5,640,555	\$ 114	\$ 298,325
4	2012	\$ 5,866,177	\$ 118	\$ 310,258
5	2013	\$ 6,100,824	\$ 123	\$ 322,668
6	2014	\$ 6,344,857	\$ 128	\$ 335,575
7	2015	\$ 6,598,652	\$ 133	\$ 348,998
8	2016	\$ 6,862,598	\$ 138	\$ 362,958
9	2017	\$ 7,137,102	\$ 144	\$ 377,476
10	2018	\$ 7,422,586	\$ 150	\$ 392,575
11	2019	\$ 7,719,489	\$ 156	\$ 408,278
12	2020	\$ 8,028,269	\$ 162	\$ 424,609
13	2021	\$ 8,349,399	\$ 168	\$ 441,594
14	2022	\$ 8,683,375	\$ 175	\$ 459,257
15	2023	\$ 9,030,710	\$ 182	\$ 477,628
16	2024	\$ 9,391,939	\$ 189	\$ 496,733
17	2025	\$ 9,767,616	\$ 197	\$ 516,602
18	2026	\$ 10,158,321	\$ 205	\$ 537,266
19	2027	\$ 10,564,654	\$ 213	\$ 558,757
20	2028	\$ 10,987,240	\$ 221	\$ 581,107
21	2029	\$ 11,426,730	\$ 230	\$ 604,351
22	2030	\$ 11,883,799	\$ 239	\$ 628,525
23	2031	\$ 12,359,151	\$ 249	\$ 653,666
24	2032	\$ 12,853,517	\$ 259	\$ 679,813
25	2033	\$ 13,367,657	\$ 269	\$ 707,006
26	2034	\$ 13,902,364	\$ 280	\$ 735,286
27	2035	\$ 14,458,458	\$ 291	\$ 764,697
Sum Total of Future Damage Prevention Benefits			\$	12,424,008
Net Present Value of Damage Prevention Benefits			\$	6,630,242
Annual Damage Prevention Benefit (2008 Dollars)			\$	406,026

Table 2. Salient Damage Prevention Benefits



Erosion Benefits		Inflation % 4.0%		
Annual Volume				
Year	Loss Prevented	Unit Price / Cu Yd.	Annual Benefit	
1	2009	-	\$ 9.68	\$ -
2	2010	-	\$ 10.07	\$ -
3	2011	19,714	\$ 10.47	\$ 206,403
4	2012	19,714	\$ 10.89	\$ 214,660
5	2013	19,714	\$ 11.32	\$ 223,246
6	2014	19,714	\$ 11.78	\$ 232,176
7	2015	19,714	\$ 12.25	\$ 241,463
8	2016	19,714	\$ 12.74	\$ 251,121
9	2017	19,714	\$ 13.25	\$ 261,166
10	2018	19,714	\$ 13.78	\$ 271,613
11	2019	19,714	\$ 14.33	\$ 282,477
12	2020	19,714	\$ 14.90	\$ 293,776
13	2021	19,714	\$ 15.50	\$ 305,527
14	2022	19,714	\$ 16.12	\$ 317,749
15	2023	19,714	\$ 16.76	\$ 330,458
16	2024	19,714	\$ 17.43	\$ 343,677
17	2025	19,714	\$ 18.13	\$ 357,424
18	2026	19,714	\$ 18.86	\$ 371,721
19	2027	19,714	\$ 19.61	\$ 386,590
20	2028	19,714	\$ 20.39	\$ 402,053
21	2029	19,714	\$ 21.21	\$ 418,135
22	2030	19,714	\$ 22.06	\$ 434,861
23	2031	19,714	\$ 22.94	\$ 452,255
24	2032	19,714	\$ 23.86	\$ 470,345
25	2033	19,714	\$ 24.81	\$ 489,159
26	2034	19,714	\$ 25.81	\$ 508,726
27	2035	19,714	\$ 26.84	\$ 529,075
Sum Total of Erosion Benefits				\$ 8,595,856
Discount Rate				4.0%
Net Present Value of Future Erosion Benefits				\$ 4,587,296
Annual Erosion Benefit				\$ 293,642

Table 3. Erosion (Reduced Fill) Benefits

Recreational Benefits

PEFS based most of their predictions on the assertion that the reef will only produce improved surf conditions 34 days a year. As we stated above, this is not an accurate assessment of the surfing enhancement possibilities of the MPASR. It certainly is not an accurate estimate of how many days people will surf the reef. PEFS should base their estimates on 204 surfing days, not 34. Additionally PEFS based their estimates on tourists who will visit Brevard County to surf the reef. This implies that Brevard County will become a surf destination, which is the point of building a surf enhancement reef. As any travelling surfer knows, even with the advent of global computer models to predict surf, no surf trip is guaranteed surf. As experienced travelling surfers, we have spent days or even weeks sitting at surf breaks around the world waiting for swell. The point is that once tourists have committed to making a surf trip, they will be at their destination spending money whether there is surf or not. One could argue that they will spend more money when the surf is flat since they will be forced to seek other forms of entertainment.

PEFS used a discount rate of 16% to estimate the recreational benefits. This was based on their assumption that the reef would be a high risk investment. They justify this rate by comparing the reef to small company stocks. Stocks, as we all know from recent events, are a risky venture where the possibility of losing all value is a real possibility. ASRA cannot envision a scenario, short of total destruction, where the reef would be worth nothing. The Narrowneck Reef economic studies used a discount rate of 8% (Raybould and Mules, 1998). The Bocombe Reef economic study used a discount rate of 6% (Weight, 2003). Certainly these projects would have to be considered equally as risky as the proposed Brevard project. So why has PEFS chosen a discount rate that is double the rates used to assess other MPASR projects?

ASR America has re-calculated the recreational benefits using 204 surfing days and a discount rate of 8%. The result is a net present value of recreational benefits of \$9,114,221 over the 25 year life of the project (Table 4).

Recreational Benefits							
Year		Annual Capacity	Tourist Share	Daily Tourist	Aggregate Sales Sales*T*90%	Total Sales SAM = 1.5	Value Added 60%
		in # of Surfers 250 Srfs x 204 days	in # of Surfers 25%	Sales (4% inc./yr)			
1	2009	-	-	\$ -	\$ -	\$ -	\$ -
2	2010	-	-	\$ -	\$ -	\$ -	\$ -
3	2011	51,000	12,750	\$ 58	\$ 663,255	\$ 994,883	\$ 596,929.50
4	2012	51,000	12,750	\$ 60	\$ 689,785	\$ 1,034,678	\$ 620,806.68
5	2013	51,000	12,750	\$ 63	\$ 717,377	\$ 1,076,065	\$ 645,638.95
6	2014	51,000	12,750	\$ 65	\$ 746,072	\$ 1,119,108	\$ 671,464.51
7	2015	51,000	12,750	\$ 68	\$ 775,915	\$ 1,163,872	\$ 698,323.09
8	2016	51,000	12,750	\$ 70	\$ 806,951	\$ 1,210,427	\$ 726,256.01
9	2017	51,000	12,750	\$ 73	\$ 839,229	\$ 1,258,844	\$ 755,306.25
10	2018	51,000	12,750	\$ 76	\$ 872,798	\$ 1,309,197	\$ 785,518.50
11	2019	51,000	12,750	\$ 79	\$ 907,710	\$ 1,361,565	\$ 816,939.24
12	2020	51,000	12,750	\$ 82	\$ 944,019	\$ 1,416,028	\$ 849,616.81
13	2021	51,000	12,750	\$ 86	\$ 981,779	\$ 1,472,669	\$ 883,601.48
14	2022	51,000	12,750	\$ 89	\$ 1,021,051	\$ 1,531,576	\$ 918,945.54
15	2023	51,000	12,750	\$ 93	\$ 1,061,893	\$ 1,592,839	\$ 955,703.36
16	2024	51,000	12,750	\$ 96	\$ 1,104,368	\$ 1,656,552	\$ 993,931.50
17	2025	51,000	12,750	\$ 100	\$ 1,148,543	\$ 1,722,815	\$ 1,033,688.76
18	2026	51,000	12,750	\$ 104	\$ 1,194,485	\$ 1,791,727	\$ 1,075,036.31
19	2027	51,000	12,750	\$ 108	\$ 1,242,264	\$ 1,863,396	\$ 1,118,037.76
20	2028	51,000	12,750	\$ 113	\$ 1,291,955	\$ 1,937,932	\$ 1,162,759.27
21	2029	51,000	12,750	\$ 117	\$ 1,343,633	\$ 2,015,449	\$ 1,209,269.64
22	2030	51,000	12,750	\$ 122	\$ 1,397,378	\$ 2,096,067	\$ 1,257,640.43
23	2031	51,000	12,750	\$ 127	\$ 1,453,273	\$ 2,179,910	\$ 1,307,946.04
24	2032	51,000	12,750	\$ 132	\$ 1,511,404	\$ 2,267,106	\$ 1,360,263.88
25	2033	51,000	12,750	\$ 137	\$ 1,571,860	\$ 2,357,791	\$ 1,414,674.44
26	2034	51,000	12,750	\$ 142	\$ 1,634,735	\$ 2,452,102	\$ 1,471,261.42
27	2035	51,000	12,750	\$ 148	\$ 1,700,124	\$ 2,550,186	\$ 1,530,111.87
Sum Total of Future Recreation Benefits							\$ 24,859,671
Discount Rate							8.0%
Net Present Value of Future Recreation Benefits							\$ 9,114,221

Table 4. Recreational Benefits

Surf Event Benefits

The surf event benefits presented by PEFS are predicated on the assumption that the reef must draw in a new ASP 5-Star event in order to be successful. While it would be desirable to bring a new ASP 5-Star event to Cocoa Beach, it is certainly not necessary in order for the reef to host profitable surfing events. The National Kidney Foundation (NKF) Surf Festival, held every labor day in Cocoa Beach, routinely generates well over \$3 million in revenues for Brevard County. An economic impact study commissioned by the Tourism Development Council (TDC) in 1996 estimated that the NKF Surf Festival generated \$3.2 million dollars in revenue, independent of other labor day weekend sales figures (NKF, 2008). Rick Salick, Director of the NKF Surf Festival, stated that he is confident that an artificial surfing reef could draw at least one extra surf event to Cocoa Beach (Salick, 2008). Mitch Varnes, promoter of the Sebastian Inlet Surf Contest, agreed with that opinion (Varnes, 2008).

Based on the faulty assumption that an ASP 5-Star event would be required, PEFS used a conditional probability multiplier to reduce the probability of success of a surf event to virtually nil. This methodology is overly conservative and does not accurately reflect the benefits possible from a surf event held on the reef. Additionally, PEFS again used a discount rate of 16% which is not consistent with other economic impact assessments performed for similar projects.

ASR America has re-calculated the event benefits without the probability multiplier and using a discount rate of 8%. A conservative estimate of \$2,000,000 in total sales was used for this calculation.

The result is a net present value of event benefits of \$13,744,795 over the 25 year life of the project (Table 5).



Surf Event Benefits				Inflation %	
		Event Total	Value Added	Local Funding	Event Benefits
Year		Sales (Int 4%)	60% total sales	Share (Int 4%)	Value Added
1	2009	\$ -	\$ -	\$ -	\$ -
2	2010	\$ -	\$ -	\$ -	\$ -
3	2011	\$ 2,000,000	\$ 1,200,000	\$ 150,000	\$ 1,050,000
4	2012	\$ 2,080,000	\$ 1,248,000	\$ 156,000	\$ 1,092,000
5	2013	\$ 2,163,200	\$ 1,297,920	\$ 162,240	\$ 1,135,680
6	2014	\$ 2,249,728	\$ 1,349,837	\$ 168,730	\$ 1,181,107
7	2015	\$ 2,339,717	\$ 1,403,830	\$ 175,479	\$ 1,228,351
8	2016	\$ 2,433,306	\$ 1,459,983	\$ 182,498	\$ 1,277,486
9	2017	\$ 2,530,638	\$ 1,518,383	\$ 189,798	\$ 1,328,585
10	2018	\$ 2,631,864	\$ 1,579,118	\$ 197,390	\$ 1,381,728
11	2019	\$ 2,737,138	\$ 1,642,283	\$ 205,285	\$ 1,436,998
12	2020	\$ 2,846,624	\$ 1,707,974	\$ 213,497	\$ 1,494,477
13	2021	\$ 2,960,489	\$ 1,776,293	\$ 222,037	\$ 1,554,256
14	2022	\$ 3,078,908	\$ 1,847,345	\$ 230,918	\$ 1,616,427
15	2023	\$ 3,202,064	\$ 1,921,239	\$ 240,155	\$ 1,681,084
16	2024	\$ 3,330,147	\$ 1,998,088	\$ 249,761	\$ 1,748,327
17	2025	\$ 3,463,353	\$ 2,078,012	\$ 259,751	\$ 1,818,260
18	2026	\$ 3,601,887	\$ 2,161,132	\$ 270,142	\$ 1,890,991
19	2027	\$ 3,745,962	\$ 2,247,577	\$ 280,947	\$ 1,966,630
20	2028	\$ 3,895,801	\$ 2,337,481	\$ 292,185	\$ 2,045,296
21	2029	\$ 4,051,633	\$ 2,430,980	\$ 303,872	\$ 2,127,107
22	2030	\$ 4,213,698	\$ 2,528,219	\$ 316,027	\$ 2,212,192
23	2031	\$ 4,382,246	\$ 2,629,348	\$ 328,668	\$ 2,300,679
24	2032	\$ 4,557,536	\$ 2,734,522	\$ 341,815	\$ 2,392,706
25	2033	\$ 4,739,838	\$ 2,843,903	\$ 355,488	\$ 2,488,415
26	2034	\$ 4,929,431	\$ 2,957,659	\$ 369,707	\$ 2,587,951
27	2035	\$ 5,126,608	\$ 3,075,965	\$ 384,496	\$ 2,691,469
Sum Total of Event Benefits					\$ 43,728,204
Discount Rate					8.0%
Net Present Value of Event Benefits					\$ 13,744,795

Table 5. Surf Event Benefits

Fishing and Diving Benefits:

PEFS did not include any benefits for fishing and diving around the reef.

The environmental assessment, prepared by CSA, has predicted the that :

Shore- or vessel-based anglers would likely fish around the ASR, depending on individual access. Fishers operating from shore would be limited to fishing over portions of the reef within casting or wading range. Some fishers may use small, self-deployed watercrafts such as kayaks or surfboards to reach a reef outside of the surf zone. Access by fishers operating from larger boats will be limited to calm days with no ground swell or wind-generated waves or by the size of their vessel. The distance to the nearest inlet (Canaveral) is considerable and would limit the number of days that small vessels would be able travel to the site.

Divers (primarily snorkelers) would utilize the proposed ASR; but, because of the generally poor visibility during much of the year, most divers would likely be spearfishers less concerned about water clarity and sight-seeing, instead using the guise of murky water as way to more closely approach their quarry when hunting (e.g., sheepshead, flounder, and gray snapper). Given appropriate conditions during the summer months, water clarity would be adequate for sight-seeing by snorkelers and possibly SCUBA divers. Similar to fishers, divers would be limited by mode of operation, accessibility, and sea conditions.

There is no doubt that the reef will attract marine life and become a popular fishing and diving site when the conditions are favorable. Indeed it is fortuitous that the conditions which will not be favorable for surfing, calm seas, will be the best conditions for fishing and diving. Of course the reef will have to be buoyed to prevent boaters from running aground or damaging the reef . We do not understand the reference to the considerable distance to Port Canaveral since the proposed reef site is only three miles from the Port Canaveral entrance.

PEFS assertion that the reef could not become both a prime fishing spot and surf break is not supported by any real data. As mentioned above, the ideal days for each sport are mutually exclusive and should not pose a problem. The Narrownneck Reef has succeeded as both a surf break and a fishing spot (Jackson, 2007). Sebastian Inlet is another example of a prime surf break which is also a prime fishing spot.

Additional Benefits:

The economic assessment, prepared by Praecipio EFS (PEFS), unfortunately only focuses on the recreational and event benefits directly related to surfers using the reef. Many other aspects of economic benefit are not considered. For example, no attempt was made to estimate the marketing value associated with a reef project. The Bournemouth Borough Council in England estimated that the media exposure due to the planning and construction of the surfing reef at Boscombe has been worth at least £10M (\$20,000,000 US) to the Council and community in free publicity. Note the recent notoriety created by the deployments of large ships as artificial reefs (Spiegel Grove in Key Largo and aircraft carrier in Pensacola). Economic studies for those projects show a tremendous amount of benefits in addition to that provided only by the divers diving these sites.

Other studies of benefits associated with the construction of multi-purpose reefs at various locations around the world have all shown significant positive benefit/cost ratios. The lowest being approximately 20:1 for the reef in Boscombe, UK (Weight, 2003), to over 60:1 for the Narrowneck reef on the Gold Coast, Australia (Raybould and Mules, 1998). Since construction of the Narrowneck reef, the Benefit/Cost ratio has been re-evaluated at 70:1 (McGrath, 2002). The Benefit/Cost estimates cited above make it very hard to reconcile the economic impact estimates presented by PEFS and CTC.

PEFS did not include any provisions for marketing, public relations, fishing, diving, or other factors typically included in economic impact assessments of this nature in their report. In light of these facts and the items described previously, ASR America considers the economic benefits presented by PEFS to be unreasonably low.

Summary of Benefit to Cost Analysis:

ASR America has prepared B/C ratios for four different conditions. These conditions have been numbered 6 through 9 in order to avoid confusion with CTC's analysis. We utilized the same methods of calculation as CTC to provide a basis for comparison. These B/C ratios are considered very conservative because they do not include any benefits for marketing, public relations, fishing, diving, or other factors typically included in economic impact assessments of this nature.

Condition 6: Coastal Protection, Surf Event and Recreational Benefits

Summary of Recreation Benefits	
Present Value of Recreation Benefits	\$ 9,114,221
Present Value of Event Benefits	\$ 13,744,795
Present Value of Recreation & Event Benefits	\$ 22,859,016
Interest Rate	4%
Annual Recreation and Event Benefits	\$ 1,463,250

Summary of Benefit Cost Analysis	
Annual Erosion Benefit	\$293,642
Annual Recreation & Event Benefits	\$1,463,250
Annual Damage Prevention Benefit	\$406,026
Total Annual Benefit	\$2,162,919
Total Annual Cost	\$540,087
Benefit / Cost Ratio	4.00



Condition 7: Surf Event and Recreational Benefits Only. No Coastal Protection.
Reef designed strictly for surf enhancement.

Summary of Recreation Benefits	
Present Value of Recreation Benefits	\$ 9,114,221
Present Value of Event Benefits	\$ 13,744,795
Present Value of Recreation & Event Benefits	\$ 22,859,016
Interest Rate	4%
Annual Recreation and Event Benefits	<u>\$ 1,463,250</u>

Summary of Benefit Cost Analysis	
Annual Erosion Benefit	\$0
Annual Recreation & Event Benefits	\$1,463,250
Annual Damage Prevention Benefit	\$0
Total Annual Benefit	<u>\$1,463,250</u>
Total Annual Cost	<u>\$540,087</u>
Benefit / Cost Ratio	2.71

Condition 8: Coastal Protection and Recreational Benefits Only.
Reef too far offshore to support surf contests.

Summary of Recreation Benefits	
Present Value of Recreation Benefits	\$ 9,114,221
Present Value of Event Benefits	\$ -
Present Value of Recreation & Event Benefits	\$ 9,114,221
Interest Rate	4%
Annual Recreation and Event Benefits	<u>\$ 583,419</u>

Summary of Benefit Cost Analysis	
Annual Erosion Benefit	\$293,642
Annual Recreation & Event Benefits	\$583,419
Annual Damage Prevention Benefit	\$406,026
Total Annual Benefit	<u>\$1,283,087</u>
Total Annual Cost	<u>\$540,087</u>
Benefit / Cost Ratio	2.38



Condition 9: Coastal Protection Benefits Only.

Summary of Recreation Benefits	
Present Value of Recreation Benefits	\$ -
Present Value of Event Benefits	\$ -
Present Value of Recreation & Event Benefits	\$ -
Interest Rate	4%
Annual Recreation and Event Benefits	\$ -

Summary of Benefit Cost Analysis	
Annual Erosion Benefit	\$293,642
Annual Recreation & Event Benefits	\$0
Annual Damage Prevention Benefit	\$406,026
Total Annual Benefit	\$699,668
Total Annual Cost	\$540,087
Benefit / Cost Ratio	1.30

Based on the Benefit to Cost analysis performed by ASR America, a Multi-Purpose Artificial Surfing Reef could be designed and built to enhance coastal protection, recreation, and economics in Brevard County.

A Multi-Purpose Artificial Surfing Reef in Brevard County would be economically justified and qualify for state or federal cost-sharing.

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