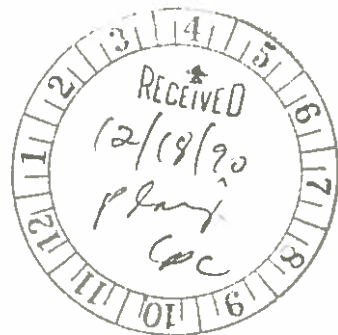


91-017

**ADDENDUM TO
ENVIRONMENTAL ASSESSMENT
for the
MICRODREDGING OF TUMON BAY
ADJACENT TO THE FUJITA HOTEL**



**Prepared for
T & NN INTERNATIONAL**



**ASSOCIATES, INC
CONSULTING ENGINEERS**

DECEMBER 1990

ADDENDUM TO ENVIRONMENTAL ASSESSMENT

FOR THE

MICRODREDGING OF TUMON BAY

ADJACENT TO THE FUJITA HOTEL

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IMPACTS OF PROPOSED MICRODREDGING
OF TUMON BAY ADJACENT TO THE FUJITA HOTEL

BACKGROUND

The owners of the Fujita Guam Tumon Beach Hotel propose to dredge a 1000-foot by 150-foot area of Tumon Bay located adjacent to the hotel property. An estimated volume of 18,033 cubic yards of sediment and substrate would be excavated to lower the floor elevation by 3 feet at a maximum. This proposed project will be the fourth such area in Tumon Bay. The swimming area at Ypao Beach Park was the first dredged, having been excavated in the late 1950's. The total area of the dredging is approximately 120,000 square feet. The original depth of excavation could not be verified. The Hilton Hotel dredged an area of approximately 40,000 square feet in 1973. The Pacific Star was permitted to dredge 40,000 square feet in 1984. One other dredging permit was approved for the Pacific Island Club in 1985 to remove 4500 cubic yards of material but no work has been performed.

Permission for maintenance dredging was including in the general dredging permits issued for these previous projects. Maintenance dredging has only been performed twice, once in 1962 at Ypao Beach Park and once in 1979 at the Hilton Hotel. Since that time, it has evidently not been necessary to maintain the excavated areas.

CURRENT AND WAVE MODIFICATIONS

Currents in Tumon Bay have been found in previous studies to be caused primarily by tidal action and long-period waves breaking on the reef. The currents generally flow north along the shore, past the previous and proposed dredging sites and out through the San Vitores channel. The average current velocity for the bay has been found to be 0.2 feet per second (ft/s) (Sea Engineering , 1987). Drogues were used to determine the currents in the immediate area of the proposed dredging project. The currents were found to flow in a northwesterly direction at speeds ranging from 0.04 to 0.21 ft/s.

Long-period waves approach from the southwest and break on the outer reef near the Hilton Hotel. The waves are usually under 4 feet in height, exceeding this height only 6 percent of the time. Waves of 0 to 6 inches in height reform within the bay. Under storm conditions, waves of 1 to 2 feet can reach the shore and during true typhoons the waves may be several feet high.

Measurements from the Apra Harbor tide gauging station are considered applicable to Tumon Bay for these purposes. The mean tide level is 1.45 feet, with the mean lower low water elevation at 0.0 feet and the mean higher high water level at 2.40 feet. The recorded extremes are -1.90 and 3.30 feet.

A computer model was developed to simulate the circulation pattern in Tumon Bay and, therefore, determine the impact of dredging on the current structure. The shallow water finite-difference model describes long-period waves forcing the ocean boundary of the bay. The model is based on time-stepping long wave, frictionless, shallow water equations. The partly linearized shallow water equations are solved by the finite difference method and Richardson scheme.

Once calibration of the model was completed, it was used to simulate circulation in the bay before and after the proposed dredging. The circulation pattern in Tumon Bay 8 minutes after flood tide, as simulated by the model is shown in Figure 3-2. The pattern is in general agreement with measurements and observations reported in other studies. Any minute discrepancies are attributed to linearization of governing equations, elimination of friction terms and lack of detailed bathymetric data for the entire bay.

Results of a similar simulation after implementation of the proposed dredging scheme is presented in Figure 3-3. Comparison of the last two figures show that dredging the bay to the extent proposed will cause significant alteration of the circulation pattern in the bay.

As a result of dredging, current velocities in the dredged area will decrease by almost 40 percent. This reduction, in turn, may be adequate to further reduce beach erosion.

The previous dredging projects in Tumon Bay have not produced any noticeable changes in the circulation patterns of the bay either. The beach near the swimming holes does not exhibit any signs of erosion or sediment deposition which would be found if the current patterns had been disrupted. The lack of maintenance dredging which has been required shows that the dredged areas have not increased the current velocities in the surrounding areas which would increase sediment movement. The proposed seawall will not impact the currents or waves because it will be located above the MHHW elevation.

SEDIMENTATION

One of the major impacts from dredging is increased turbidity leading to sedimentation. This problem will be mitigated through the use of silt curtains. The dredging area will be divided into segments 200 x 150 feet with the curtains while the dredging is performed. The curtains will not be removed until the turbidity has decreased to an acceptable level. This method was successful for the previous operations.

Other safeguards that will be used in this project include onshore settling and no ocean disposal of sediment. The dredged material will be pumped to settling ponds located on the hotel property above the beach. These ponds will be located far enough from the mean high water line that even if the reinforced walls should fail, the sediment will not wash into the ocean. The dredged material will be dewatered in the settling ponds with only clear water returned to the ocean either through percolation or through the discharge pipe. The discharge pipe will be encased in a filter fabric which will prevent the escape of any fine sediment. The dewatered material will be used for beach nourishment above the mean higher high water line or in the construction of the new Fujita Hotel which will be occurring simultaneously. No sediment will be disposed of in the ocean. In addition, analysis of the sediment showed very little fine material, so the performance of the settling ponds will be enhanced.

The dredging project is intended to stabilize the beach against future erosion by preserving the existing beach slope and reducing the impinging wave velocities. The dredged area will also act as a sediment trap because of the reduced current velocity in the area. The proposed seawall will protect the beach front property from erosion during typhoons and high wave conditions. In these ways the project will protect against future erosion and sedimentation.

HABITAT MODIFICATION

The bay is frequently divided into three zones when discussing the types of habitats. The intertidal zone is located between the low and high water levels on the shore. The inner reef flat extends from the low water line to the elevated outer reef. The outer reef flat is the elevated reef that extends to the open ocean. The outer reef flat is frequently exposed during low tides.

The intertidal zone is the least diverse region biologically. The water is extremely shallow and so becomes very warm. The algae Enteromorpha clathrata is the most common plant in this region. This algae is considered a nuisance by the hotels because it's not attractive to the visitors, but it is the favorite food of the juvenile rabbitfish, manahac. A few fish maybe found here during high tides. The only other common inhabitants are sea cucumbers and crabs.

The inner reef flat is characterized by shallow, warm water and a sandy bottom. Few corals can be found in this zone near the Fujita Hotel, but plants are much more common. Two areas of rich coral growth can be found near the Hilton and Pacific Star swimming areas within the inner reef flat. These two areas are historically the only such areas in Tumon Bay. Fish and sea cucumbers are also common in this zone.

The outer reef flat is the richest zone in coral growth because of the rocky bottom. The reef is exposed during low tides which limits the coral height. Pools form holding plants and animals during low tides. The cooler, rich water from the ocean provides a better environment for corals and fish than do the other zones.

The inner reef flat will be directly impacted by the dredging. Any plants and sedentary macroorganisms will be removed with the dredging operations. Mobile creatures such as fish and crabs will move out of the immediate area of the dredging. It is not expected that any live coral will be found in the proposed dredging area because of the sandy bottom and warm water temperatures. The planned mitigation procedure is to relocate any live corals found to suitable habitat outside of the project boundary. The other species of plants and animals will readily repopulate the dredged area, as occurred at the previously dredged sites.

The proposed dredging will result in a deeper section of the inner reef flat. The natural slope of the beach will not be disturbed so that erosion in the future is not encouraged. The edges of the dredged portion will be excavated at a stable slope also. The deeper water will provide a better habitat for fish by providing a greater volume of water and cooler temperatures, especially during low tides. By excavating down to the hard limestone substrate, the dredging will provide a potential habitat for corals, if the water temperature is correct. The dredging will not have any negative impact on the surrounding environment, as seen at the other dredging sites.

The proposed seawall will be placed in an area that has already been altered to meet human needs. Existing walls will be removed and replaced by the proposed low wall. There will be no change to the existing shoreline habitat by this project.

IMPACTS ON LIVE CORAL

Coral is the indicator of reef health because it is the foundation of the habitat and is sensitive to changes in the environment. There are healthy colonies of live coral near the dredged swimming holes at the Hilton Hotel, Ypao Beach Park, and the Pacific Star Hotel. These colonies have been noted in environmental surveys dating back to before the Hilton dredging was proposed. There has been no evidence that these colonies have been harmed by the dredging projects. There are no colonies of live coral near the proposed dredging at the Fujita Hotel. There are a few small live corals scattered through the inner reef flat beyond the Fujita Hotel property, but the nearest location of numerous corals is the outer reef flat. The outer reef flat will not be affected by the proposed dredging project.

The mitigation measures that will be used to maintain the water quality will protect the corals from suffering indirectly from the dredging activity. The dredging will not directly disturb any live coral. In the unlikely event that live coral is found within the proposed dredging boundary, it will be relocated to a suitable place outside of the dredging area. This is not expected to be necessary as no corals were found during the field work preliminary to this proposal. Therefore, there will be no impact on corals by this dredging.

IMPACTS TO RECREATION

The Tumon area is the center of tourism in Guam with the bay being a focal point for recreation and its scenic beauty. Non-motorized water sports such as swimming and windsurfing are very popular. Motorboats and jetskis have been prohibited from operating in Tumon Bay, except for transiting between the beach and ocean. Snorkeling, sunbathing and strolling on the beach are also popular pasttimes. Fishing has been prohibited within the reef by the Department of Agriculture since the spring of 1990. Prior to the restrictions fishing was declining in popularity, probably due to the increase in the tourist population.

During the dredging period, there will be some minor disturbances to beach users because of the equipment and silt curtains. The beach will remain accessible because the piping needed for dredging will be buried below the surface. The bay will be unaffected except for the area enclosed by silt curtains. The phasing of work will keep the enclosed area to under 400 x 150 feet, at any time. There will be increased noise due to the dredging, but this should be minimal compared to the noise from the construction of the new Fujita Hotel. Beach goers can avoid the area of dredging by moving a few feet down the beach.

After completion of the dredging, recreation will be enhanced. The beach and shallows will be essentially the same as they are now. The dredged area will be deeper and therefore a better area for swimming, snorkeling or windsurfing. The water depth will be up to 3 feet deeper, or an average of 4.5 feet deep during low tide which will increase the use of the area. Access to the beach will be increased because the existing private residences will be replaced by the open hotel grounds. The seawall will have at least three sets of stairs allowing easy passage to the beach.

CONCLUSIONS

The use of dredging for construction of swimming holes or beach nourishment, has been found over the years to be a stable, non-destructive practice. The proposed dredging adjacent to the Fujita Hotel will not impact the bay currents or residence time of the bay. The natural environment is not rich in life or sensitive so that the impacts will be minor and quickly restored. The recreational use of the beach and bay will be improved in the area. The beach will be stabilized and less prone to erosion by waves or runoff due to this project. This proposed dredging, seawall and beach restoration will protect and improve the natural and human environments.

RESPONSE TO COMMENTS BY
GUAM DEPARTMENT OF AGRICULTURE

COMMENT # 1: The brief project review of the environmental assessment states that "the project will have no known adverse effects on the marine environment" and this is not consistent with the scope of the proposal. The project plans to remove 18,033 cubic yards of substrate which will remove the existing substrate surface habitat and create a new habitat which will support a different community of marine life. This proposal will certainly create an adverse impact to the existing environment.

RESPONSE: We concur that due to the removal of substrate the marine habitat will change. However, since the proposed dredge site does not support rich marine life and the moat region will remain intact, any habitat change will not be significant. Furthermore, we have demonstrated that the dredging will not change the dynamics of circulation within the bay. The dredged zone will reach equilibrium with the surrounding area and be capable of supporting marine life. We do not believe that creating a different habitat is necessarily an adverse impact on the environment.

COMMENT # 2: Dredging proposals in Tumon Bay have become a common request by hotel management to "improve beach and water quality". DAWR has expressed in the past and still concludes that dredging in Tumon Bay is not advisable. This report expended considerable time and effort to address the circulation and wave propagation questions which are generally raised, but several assumptions and statements contradict the value of this work.

- a: The circulation model is based on frictionless shallow water equations, which basically implies that effects of all relief (corals, rock, etc), and the effects of the substrate have been removed. This means the values generated for this model are reasonably independent of the morphology within Tumon Bay. This fact was implied briefly in the text by the statement that the geology was represented as realistically possible. The values entered for coastal shoreline were all zero, but this concept is contradicted by the earlier statement that the coastal beach in front of the Fujita Hotel is slowly eroding. Although this model may be the best attempt at simulating the situation in Tumon Bay, DAWR feels the factors which can not be simulated make use of this information limiting.

RESPONSE: In the absence of actual values for factors such as friction of the reef habitat, and actual bathymetric map with high resolution, use of a simplified model for predicting circulation within the bay is justifiable. More importantly, the model does represent the general circulation pattern in the bay.

COMMENT b: The model analyzes the information generated by using a finite difference method and Ricahrdson scheme. This procedure comparatively analyzes the differences between each of the squares within the grid system. This procedure compares the differences which occur between the existing conditions at the proposed dredge site and the conditions which will exist after the site has been dredged. This seems practical except that the results are masked by the fact the entire bay is used for the model. Only the dredge area will have different data values for the input of the circulation model. If the results compare squares in the grid for all of Tumon Bay the localized effects of the dredging project will insignificant by the law of areas (small area compared to a large area) under study. As has been done in the past, this project considers the effects of dredging on a site specific basis. The circulation model for Tumon should address the effects of dredging in Tumon Bay which considers all dredge sites and their cumulative impact.

RESPONSE: The model varifies the fact that proposed dredging which is aimed at a very small area of the bay, would have a localized effect. Currents in the vicinity of the dreded area would change, however the overall circulation in the bay would not be impacted drastically. Though, we concur that a better picture of circulation pattern in the bay is presented if all other existing and proposed dredging projects are accounted for. However, detailed information about the proposed projects are not easily available and therefore not included in the model.

COMMENT c: A single dredge site which is small by comparison to all of Tumon Bay is not going to have much impact on circulation patterns but will effect intensity and residence time on a small scale. The effects of dredging on a cumulative scale need to be addressed because other island areas have lost valuable reef habitats from dredging in bays such as Tumon through alteration of circulation, residence time, sediment transport.

RESPONSE: The model predicts the currents in the proposed dredged pool will decrease by 40 percent. This in turn causes the residence time in the pool to decrease accordingly. We concur that the cummulative effects of all dredging projects should be evaluated. However, a comprehensive environmental impact statement for dredging of Tumon Bay concluded dredging of a 150' wide area extending the length of the beach will not have a severe environmental impact on the bay.

COMMENT d: A simple comparison as requested on page 3-7 of Figures 3-2, 3-3 which describe the model generated circulation patterns and the results of Randall and Jones' work described in Figure 2-20, does not support general agreement with measurements and observations reported in other studies as indicated.

RESPONSE: Disagree. As mentioned on page 3-7 of the report, the results of the model is in general agreement with previous works including Randall and Jones. The minor discrepancies are due to model simplifications.

COMMENT # 3: The plan indicates that benefits of this project will include attraction of fish because of increased depth and improved suitability for coral growth. In tropical coral reef systems the presence of relief habitat (corals, rocks, drop-offs etc) or an increase in available food are the criteria for improvement of fish abundance. The area in question has not traditionally supported much coral because of sedimentation. This area, as indicated in the report will become a sediment sink and therefore no provide much suitable habitat for coral settlement or growth. There is also no reason to expect that food will be anymore available in the dredged area than is presently available.

RESPONSE: It is true that over time, sediment will be redeposited in the dredged area to some degree. The amount of sediment and time over which it will be deposited is difficult to predict. Sufficient time and area may occur which would allow coral colonization. The area is currently suitable for fish except for during low tides when the water is too shallow. The food supply should be sufficient during low tides in the deeper dredged areas to allow fish to remain.

COMMENT # 4: The removal of 18,033 cubic yards of sand and substrate which are a Government of Guam resource will require some form of compensation for its removal and private use. Additionally, The impact of removing the hard substrate below the sand has not been addressed. Since the average depth of the sand is 0.8 ft., 0.7 ft. of hard substrate will be removed on the average. This process could effect the stability of the bottom greatly in this area, particularly during storms.

RESPONSE: GMP Associates, Inc. was not aware that the sand and substrate to be removed is considered a government resource. We have not received any correspondence from either the Bureau of Planning or Department of Land Management on this matter, and will leave the matter to their discretion.

The stability of the bottom will not be effected as the substrate is consolidated beyond the depths of dredging. The sides of the dredge area will be excavated at stable slopes.

COMMENT # 5: The review of the marine fauna seems to indicate that the area selected for dredging lies in an area of low biological richness. This view requires additional information. According to the transect information provided, the dredge area makes contact with both the near shore and middle reef zones. These areas are certainly less rich with respect to coral and will remain poor even after dredging. If the amount and kinds of algae are compared, this area is reasonably lush and would also be likely to host a large number of burrowing organisms which are essential to maintaining a clean sediment base. This proposal does not address the impact of removing the burrowing organisms. These organisms will not survive in the hard substrate remaining after dredging until the pit begins to refill with sediment. The biological value of this area should not be underplayed just because it is sand. There many forms of marine life are dependant on such areas for food and refuge.

RESPONSE: The most recent biological survey of Tumon Bay (Barrett Consulting Group, 1988) is the source of the information on Macroinvertebrates of Central Tumon Bay as shown in Table 2-6 of this Environmental Assessment. No members of the taxa Bivalvia were found in the transects of the Central Tumon region. Based on this information, there are very few burrowing organisms in the area to be disturbed by the proposed dredging. The cleaning action of the sand provided by these organisms will not be needed in the dredged area until there is sand in it again, at which time, the macroinvertebrates will naturally recolonize the area. Our assessment stands that the proposed dredging will not cause an adverse impact on the general population of macroinvertebrates.

COMMENT # 6: Specific mention of the marine environment in Tumon Bay being unfavorable for giant clams was also stated. The fact that large clams are associated with open water on Guam is only a function of harvest and not survivability. This problem exists even with it being illegal for giant clams to be harvested from Tumon Bay. Juvenile giant clam (*Tridacna*) are common in Tumon Bay.

RESPONSE: No members of the Bivalia taxa were found in the Central Tumon region by the referenced biological survey. The proposed dredging will neither encourage nor discourage harvesting of clams.

COMMENT # 7: The proposed method of dredging was described as hydraulic dredging, but if insufficient submergence water pressure is available, then mechanical methods will be utilized. In consideration of either method, DAWR requests full description of the method to be used, a list of the number and kinds of heavy equipment, their planned use, considerations for refueling and potential impacts.

The dewatering of the sand using settling basins requires a considerable amount of saltwater to percolate down through a sand base, presumably toward the ocean. There is concern that this plan could place back pressure on emerging ground water or have enough back pressure to cause intrusion into the groundwater system.

Additionally, the section describing settling basins requires information pertaining to the method of cleaning sand for removal of bio-contaminants and the amount and kind of solutions used. These methods should consider the disposal of the wash.

RESPONSE: The equipment that is proposed for use in dredging is as follows:

- 1 - Cutter Suction Dredge with discharge pipe.
- 1 - Backhoe with 0.9 cubic meter bucket, hydraulic rock breaker and hydraulic cutter.
- 1 - Booster station to be located on land, if needed, to pump sediment to settling ponds.
- 2 - Backhoes with 0.3 cyd buckets for use at the settling basins.
- 2 - Dump trucks, 10 T. capacity, for hauling away excess material.

The hydraulic dredge may be deployed with a floating platform and will be brought back on shore for refueling. When hard substrate must be removed, a temporary causeway will be constructed to allow the backhoe to reach the dredge area. The backhoe will be brought back on shore for refueling. Construction on the hotel expansion will be underway so there will be an appropriate site for equipment refueling.

As described in Section 3.1 of the EA, the settling basin will drain primarily through a geotextile covered, perforated pipe to the ocean. Only a small volume of seawater will percolate through the floor of the basin. Because the existing groundwater gradient is toward the ocean, any percolating water will be carried along with the groundwater and return to the ocean. Only a small volume of seawater will percolate through the floor of the basin. Because the existing groundwater gradient is toward the ocean, any percolating water will be carried along with the groundwater and return to the ocean.

Based on the sieve analysis of sediment samples from the proposed dredge area, no silt or clay particles (less than 0.05 mm in diameter) were present. Refer to Section 2.2.3 of the Environmental Assessment. Silt and clay particles provide the primary adhesive surface for biocontaminants, therefore virtually no biocontaminants are expected to be found. If the presence of a small amount of biocontaminants is found during the actual dredging, a simple washing with sea water within the settling basin should be sufficient to remove this. Should a substantial amount of biocontaminants be unexpectedly found, this material would be removed to an approved landfill location.

COMMENT # 8: The proposed plan to dredge this area is an act to delay the natural process which has been intensified by Guam's rapid development. The sand removed from this site will very likely be redeposited on site if the beach is continually renourished. This fact should be obvious due to the rate at which the beach erodes. In consideration of this idea DAWR would also like to express concern for the fact that a number of areas have already been dredged simultaneous to beach nourishment. As a result of this process, considerable amounts of sand are appearing outside of San Vitores Channel and outside the Hilton Channel. These sand covered areas are growing in size and are replacing coral habitats. Although this is not entirely the result of dredging and beach nourishment, these factors are certainly contributors.

RESPONSE: We concur with the observation that simultaneous dredging of multiple sites within Tumon Bay has contributed to increased sediment transport. However, this proposed beach nourishment will only place sand above the MHHW level, away from normal wave action during normal weather conditions. Erosion is not expected to be increased by this action. Improper stormwater management by inland occupants is causing the majority of erosion in Tumon, especially by the San Vitores channel, rather than wave action.

COMMENT # 9: The set back requirements (Section 13410 et. seq. of the Guam Coastal Management Program) demand that the seawall be placed 10 meters from the MLLW mark. The present designs indicate this wall will be placed 15 ft. above the MHHW mark which will be inside the Territorial Seashore Preserve.

The proximity of the seawall to the MHHW mark will create backwash and undercutting beach erosion during periods of heavy storm waves. The wall needs to be moved landward to avoid this problem.

RESPONSE: The seawall has been revised to be no closer than 10 meters to the MLLW line. Only the center portion of the wall is changed from the original proposal. This change is to comply with the Territorial Seashore Preserve.

During severe storms, some slight erosion may occur at the base of the seawall. However, the natural equilibrium forces of the bay will return the beach to the conditions preceding the storm within a short period of time.

COMMENT #10: The plan also indicates that no threatened or endangered species of plants or animals have been indentified in the Tumon area (2-6). A wetland in Tumon which was filled in 1989 has documented sightings of the Mariana Common Moorhen, which implies that if other wetland habitat were available and suitable that these birds could be expected to be observed.

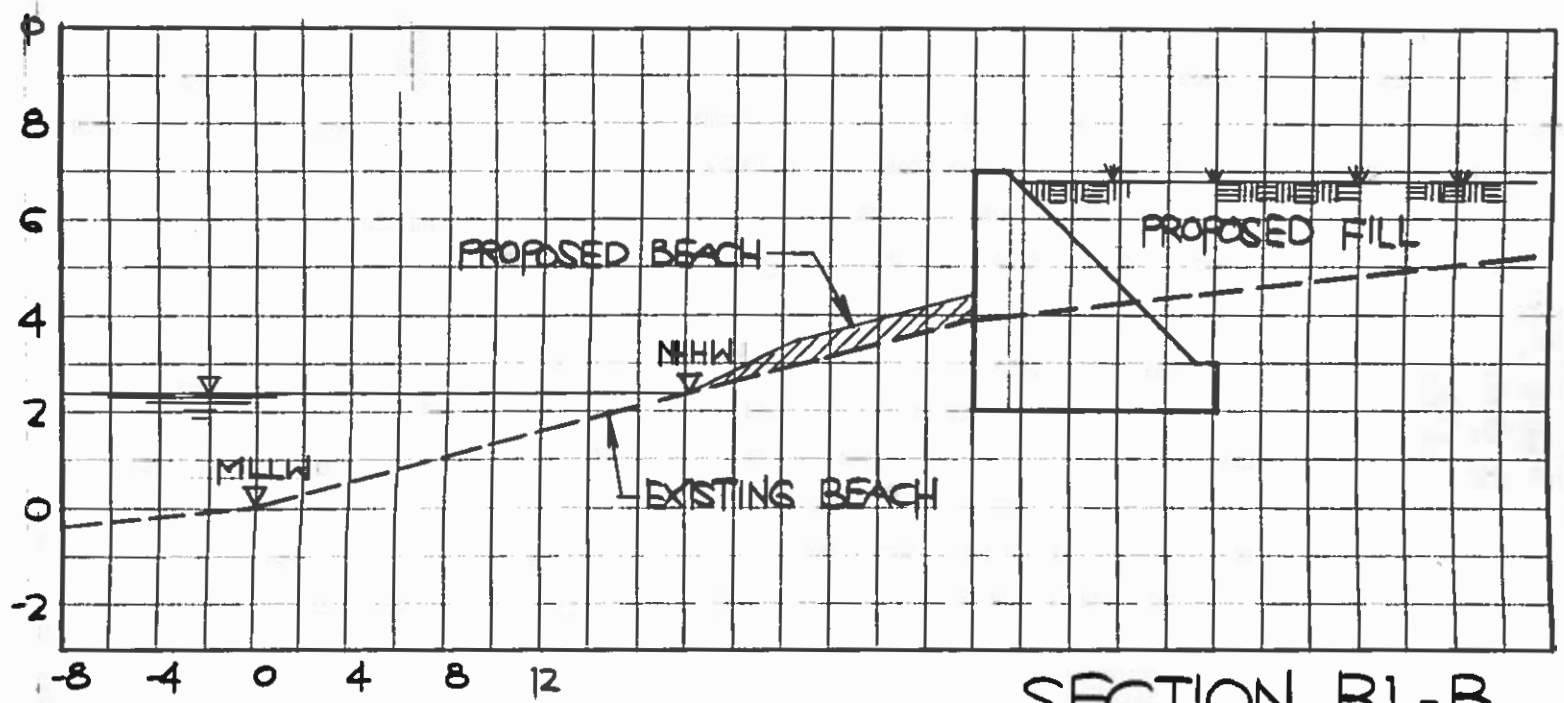
RESPONSE: We have revised our text to include mention of this sighting of the Mariana Common Moorhen. However, the beach front of the Fujita Hotel is not suitable habitat for these birds. This project will have no impact on Moorhens.

The only native resident birds that may be found in the Tumon area are the Yellow Bittern and the Marianas Common Moorhen. The Moorhen was last sighted in 1989 at an inland wetland by Department of Aquatic and Wildlife Resources personnel. The other native birds are found only in remote forests, particularly in northern Guam, according to the DAWR. Most shore birds that may be found in Tumon are migratory. Table 2-2 lists the birds seen in Central Tumon and the animals of the area.

REVISIONS TO ENVIRONMENTAL ASSESSMENT TEXT

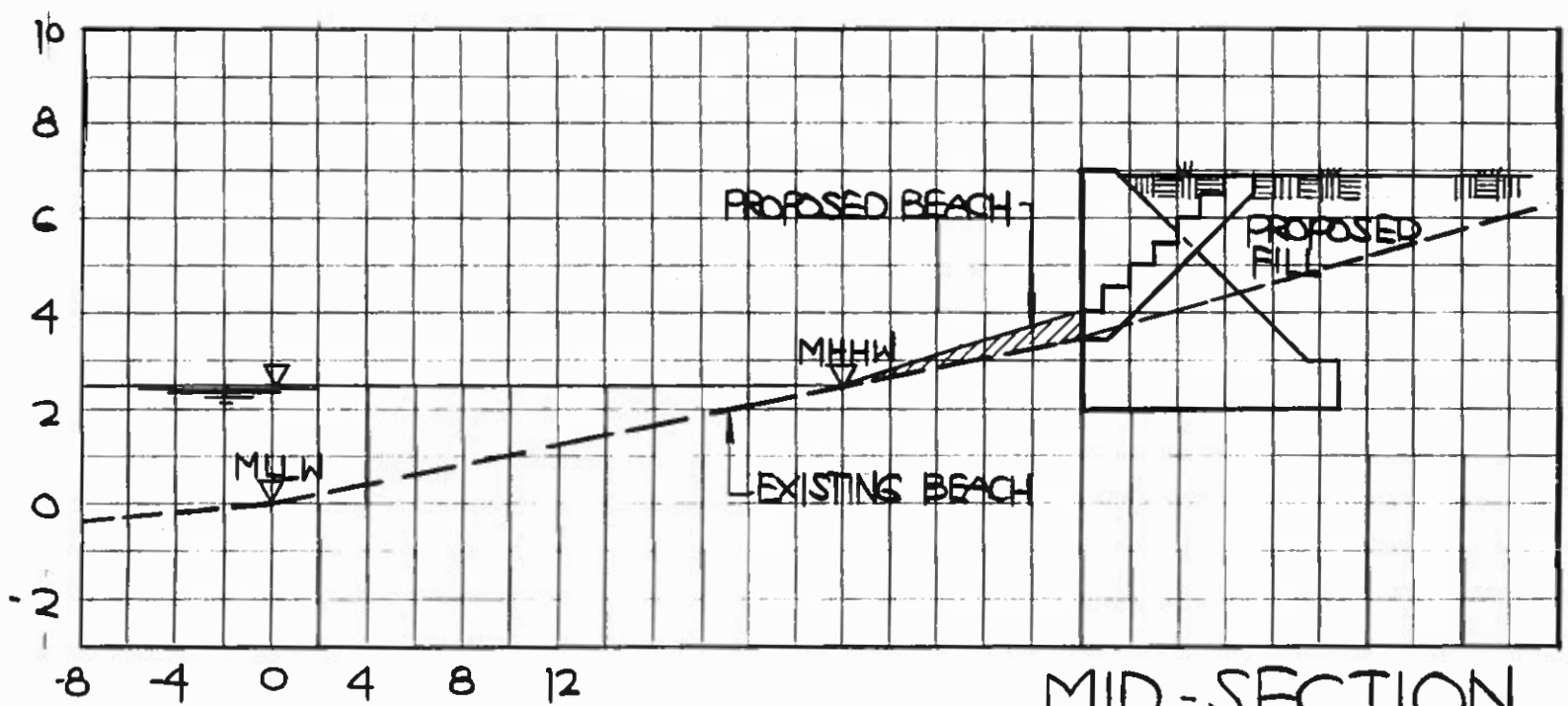
Page 2-6: The final paragraph should read:

"The only native resident birds that may be found in the Tumon area are the Yellow Bittern and the Marianas Common Moorhen. The moorhen was last sighted in 1989 at an inland wetland by Department of Aquatic and Wildlife Resources personnel. The other native birds are found only in remote forests, particularly in northern Guam, according to the DAWR. Most shore birds that may be found in Tumon are migratory. Table 2-2 lists the birds seen in Central Tumon and the animals of the area."



SECTION B1-B

SCALE: HORIZ - 2 FT. PER SQ.
VERT - 1 FT. PER SQ.



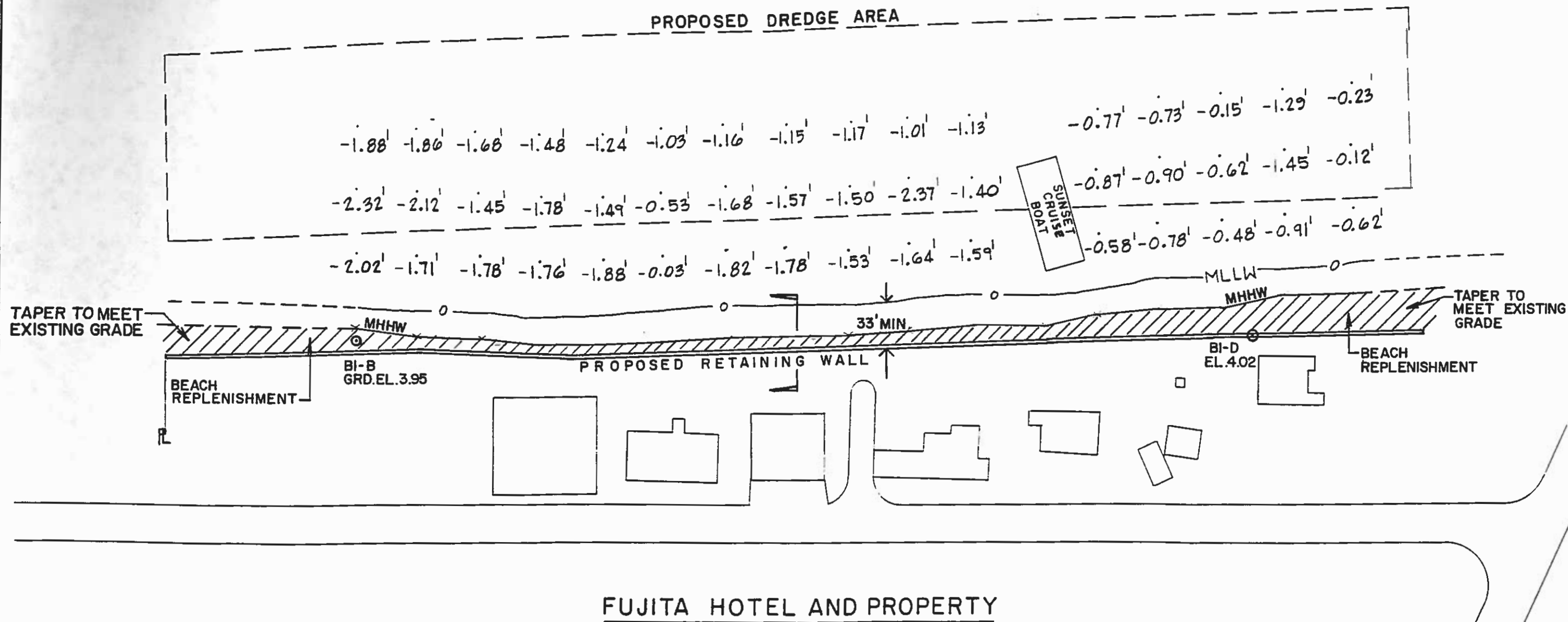
MID-SECTION

SCALE: HORIZ - 2 FT PER SQ.
VERT - 1 FT PER SQ.



SECTION B1-D

SCALE: HORIZ - 2 FT PER SQ.
VERT - 1 FT PER SQ.



REVISED FIGURE 2-3: BATHYMETRY IN VICINITY OF PROPOSED DREDGE ZONE