Sugar Cove Berm Post Maintenance Effort #4 Monitoring

Sugar Cove, Spreckelsville, Maui, Hawaii

July 2023

Prepared for:
Sugar Cove AOAO
320 Paani Place #6C
Paia, Hawaii 96779

Prepared by:
Sea Engineering, Inc.
Makai Research Pier
Waimanalo, HI 96795

Job No. 25411

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1 Background

The Sugar Cove AOAO (Association) property, located at 320 Paani Place, spans a significant portion of the cove fronting its parcel in Paia, Maui, Hawaii. The Association has solely funded and carried out restoration and maintenance of the beach along approximately 520 feet of shoreline fronting their four-acre property. Beach deflation during the 1980s led to widespread turbidity plumes emanating from the native clay bank that was exposed during beach narrowing and loss. By 1989 the entire beach had disappeared against the clay bank. In an effort to combat chronic coastal erosion and beach loss, the Association built the Hayashi seawall in 1993 and started their beach restoration efforts in 1995.

Prior to the Association's restoration efforts, the beach was completely lost and the nearshore waters of the cove were continuously impacted by the release of fine terrigenous material from the natural clay bank. During this period of beach loss, the nearshore waters, nearshore benthic environment, sandy nearshore ecosystem were heavily impacted and the sand beach ecosystem was completely lost.

The Association's restoration efforts have restored the public sand beach and its ecosystem within the cove. The restored public beach extends from the coastal armoring structures on the eastern side of the property to the natural, rocky headland on the western side of the cove. This beach restoration program has systematically added sufficient sand volume, over the previous two decades, to re-inflate the entire beach system. As part of these maintenance efforts, the Association routinely adds sand within the County access.

This privately funded, ongoing effort has reestablished the sandy coastline with a County public beach access at the eastern end; improved coastal access along the shoreline; restored the public beach resource; and eliminated the turbidity plume from the native clay bank. More importantly, this ongoing effort has restored the nearshore sandy substrate ecosystem and the sand beach ecosystem, to the benefit of green sea turtles, hawksbill sea turtles, monk seals, native shorebirds, and other fauna that routinely inhabit and utilize public sand beaches in Hawaii.

The Association is continuing their efforts through implementation of a berm restoration program. Without the ongoing restoration and maintenance efforts, history has shown that the natural environment cannot maintain sufficient sediment to support a stable beach system within the cove. Projected sea-level rise coupled with the historic loss of sediment volume indicates that in the absence of the Association's ongoing efforts, there would be no public beach, no sandy coastal access, and no sandy nearshore or beach ecosystems along this section of coastline. Coastal erosion, similar to what is happening at this site, is affecting much of the shoreline along Maui's north shore, compounding the regional impacts.

1.2 Project Location

Sugar Cove is located on the north shore of Maui in the Spreckelsville area, as shown in Figure 1-1. The cove where the Sugar Cove property is located has rocky headlands on the eastern and western sides (Figure 1-2). The property is located on the center and western portions of the cove,

with the restored sandy beach along the shoreline. The properties on both the western and eastern portions of cove have armored shorelines or clay and boulder banks. The property, Tax Map Key (TMK) (2) 3-8-002:003, has a Maui County beach access easement on the eastern boundary of the property (Figure 1-3). The County easement appears as a thin blank strip abutting the parcel. This public easement allows unrestricted access to the restored sand beach, and public trust lands, fronting and maintained by the Association.

Figure 1-1. Location map, Island of Maui

Figure 1-2. Location map, Sugar Cove AOAO

Figure 1-3. Location map, Tax Map (Sugar Cove AOAO property has a red outline)

1.3 Sugar Cove Berm Maintenance Plan Permits

State:
Department of Land and Natural Resources SSBN MA-15-02. This Category II Small Scale Beach Nourishment permit authorizes up to 8,000 cubic yards of sand placement, to be placed as needed during the duration of the 10-year permit, through multiple berm maintenance efforts. SSBN MA-15-02 permit expires on July 7, 2025.

County of Maui:
Department of Planning SMX 2015/0249, SM2 2015/0057, SSA 2015/0041, EAE 2015/0052.

1.4 Previous Berm Maintenance Effort

The first maintenance effort was supported under SSBN MA-15-02 and was conducted on November 9 and 10, 2015. This effort placed approximately 892 cubic yards of sand on the berm and 45 cubic yards on the access path.

The second maintenance effort was also supported under SSBN MA-15-02 and was conducted on September 6 and 7, 2016. This effort placed approximately 1,115 cubic yards of sand on the berm.

A third maintenance effort was approved under SSBN MA-15-02 for September 2017 but was not conducted at that time due to local issues with the sand source. In June of 2020 a new sand source, Pacific Aggregate LLC "Natural Sand Blended", was found and approved for berm maintenance at Sugar Cove. The third maintenance effort occurred on September 16, 2020. This effort placed approximately 740 cubic yards of sand on the berm.

A fourth maintenance effort was approved under SSBN MA-15-02 for September 2021. The sand source, Pacific Aggregate LLC "Natural Sand Blended," was used for berm maintenance at Sugar Cove. The fourth maintenance effort occurred on September 28, 2021. This effort placed approximately 1,111 cubic yards of sand on the berm.

1.5 Existing Coastal Conditions

The coastline between Paia and Kahului meanders along a generally north-northwest facing oriented shoreline. Numerous small embankments are located between rocky or armored headlands along this stretch. Though some areas have sand beaches, chronic shoreline retreat has resulted in beach loss or narrowing along much of this region's shoreline. Decades of sand mining combined with rising global sea level have contributed to the loss or degradation of many of these sandy beaches, as they are increasingly replaced by shoreline armoring, or they disappear against a backdrop of clay banks and boulder beaches. The once sandy headlands that were common to the area are now completely gone, with sparse sand beaches dotting a once golden shoreline.

The public sand beach at Sugar Cove is composed primarily of beach quality fill sand placed on the shoreline by the Association. The current beach sits atop and makai of the Hayashi seawall, built in 1993. The cuspate beach shape (Figure 1-4) forms a wide curve between the natural western headland and the shoreline armoring headland on the eastern side.

The shallow fringing reef attenuates much of the incident wave energy before it reaches the shoreline. A shallow sand bar has formed in the nearshore waters; further minimizing wave energy and helping to stabilize the nearshore sediment connected to the beach system. The orientation of the sand bar and shoreline wave fronts is a reflection of the beach shape.

After the berm maintenance effort in November 2015, the severe winter North Pacific swell caused sand migration to the east end of the cove. Beach profiles and topographic data indicated that the east end was inflated, while the west end and middle of the cove were similar to their pre-maintenance volumes and elevations. The second maintenance effort was undertaken due to the severe erosion the previous winter compounded with the significant time delay between the nourishment effort in 2011 and the first maintenance event in 2015.

Though the maintenance efforts have begun to revitalize the littoral cell, it is still below optimal sand volume. Based on the long beach profile record for the site, the beach berm has been stable when there is sufficient volume to withstand seasonal fluctuations. This has typically occurred when the overall berm elevation is at or just above +10 ft in elevation. An additional indicator of beach stability has been beach width in the middle of the cove at Transect 5 (Figure 1-4). A width of 100 feet has been observed during periods of beach stability, regardless of the season. Thirdly, a return of the foreshore slope to between 1V:6H to 1V:8H is another physical symptom that would indicate a need for future maintenance actions. These three physical characteristics have been identified as triggers for initiating beach maintenance at the site.

Currently, the beach at Sugar Cove is deflated. A survey conducted on May 11, 2023 found the beach berm at Transects 7 and 3 to be under +10 ft in elevation (Figure 1-5 and Figure 1-7). Additionally, beach width from the accessway to the beach toe at Transect 5 was approximately 75 ft. The slopes at the three transect locations were found to be 1V:10H at Transect 7, 1V:10H at Transect 5, and 1V:12.5H at Transect 3, indicating that the beach is losing sand and becoming flatter. These three triggers indicate that the beach has become unstable and would benefit from nourishment efforts.

1.5.1 Topography and Profiles (Local Mean Sea Level Datum)

The elevation data presented was collected from the site visit to investigate beach condition on May 11, 2023. The sand beach fronting the parcel extends 35 to 80 feet from the 0-foot contour at local mean sea level (LMSL) to the seawall's backstop, from east to west respectively. Beach profiles in the western area (Transect 7), middle area (Transect 5), and eastern area (Transect 3) have active beach face, or foreshore, slopes of 1V:10H (Figure 1-5), 1V:10H (Figure 1-6), to 1V:12.5H (Figure 1-7), respectively. The berm crest in the profiles is approximately +8 feet in elevation on average.

The nearshore is a sand field with scattered rocks in the middle of the cove. Sand ripples indicate that the sand is subject to wave orbital motion and that the grain sizes remaining are well-sorted and large enough to remain stable on the seafloor (Figure 8-40). Rocky pavement and boulders extend offshore of the western headland and eastern shoreline armoring units.

The restored beach has a stable berm between the active berm crest and the seawall's backstop (Figure 1-8, and Figure 1-9). The County beach access at the east end of the beach (Figure 1-10) has a sand slope leading inland. The full expanse of the restored beach and berm area is a public resource. Since the last maintenance effort in September 2021, the beach at Sugar Cove has stayed relatively stable at the western end but has deflated at the eastern end resulting in net erosion.

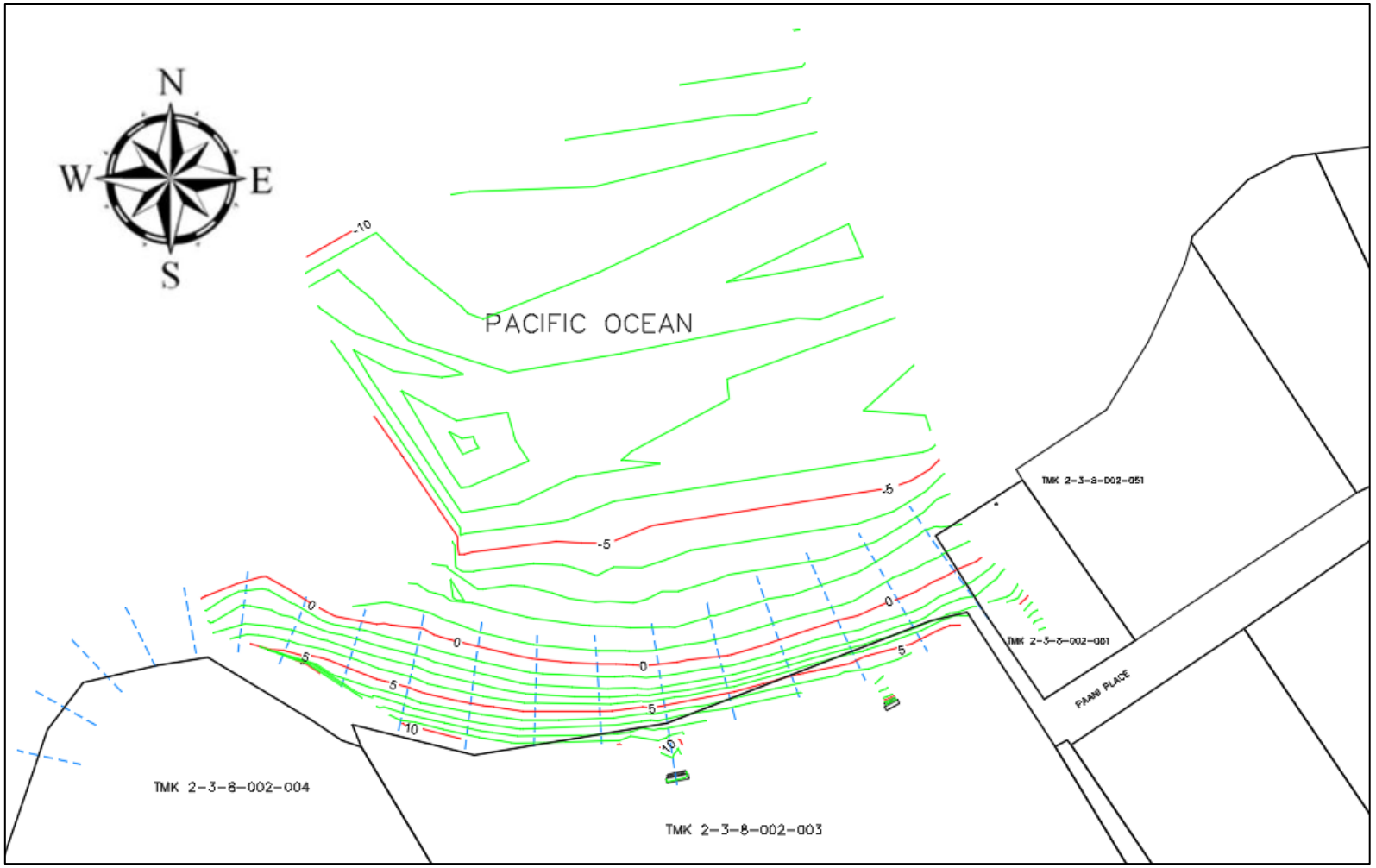


Figure 1-4. Post-Maintenance #4 topography at the project site, May 11, 2023 (LMSL datum, feet)

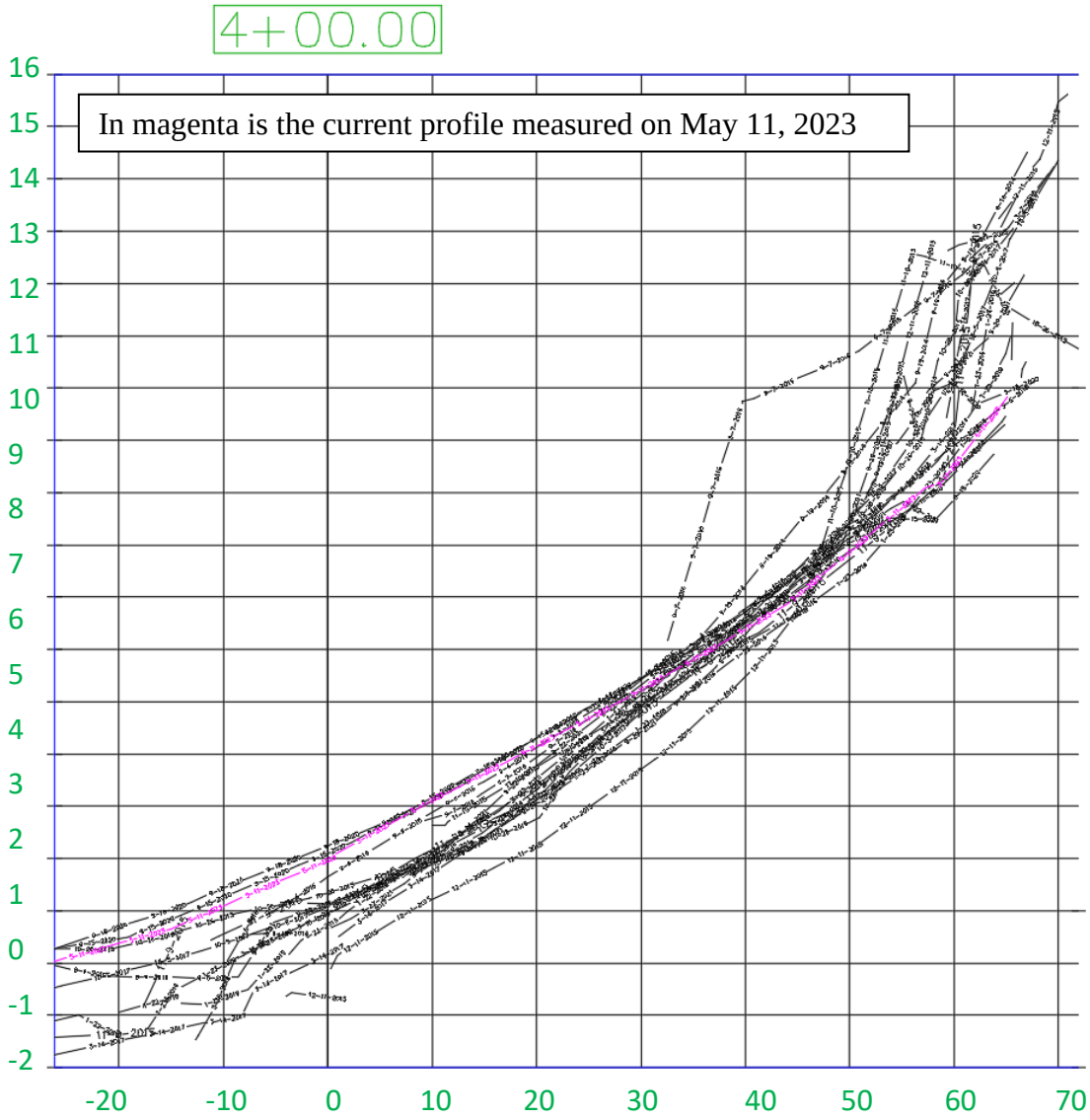


Figure 1-5. Topographic profiles at western end of Sugar Cover over 2014-2023 (LMSL Datum, feet)

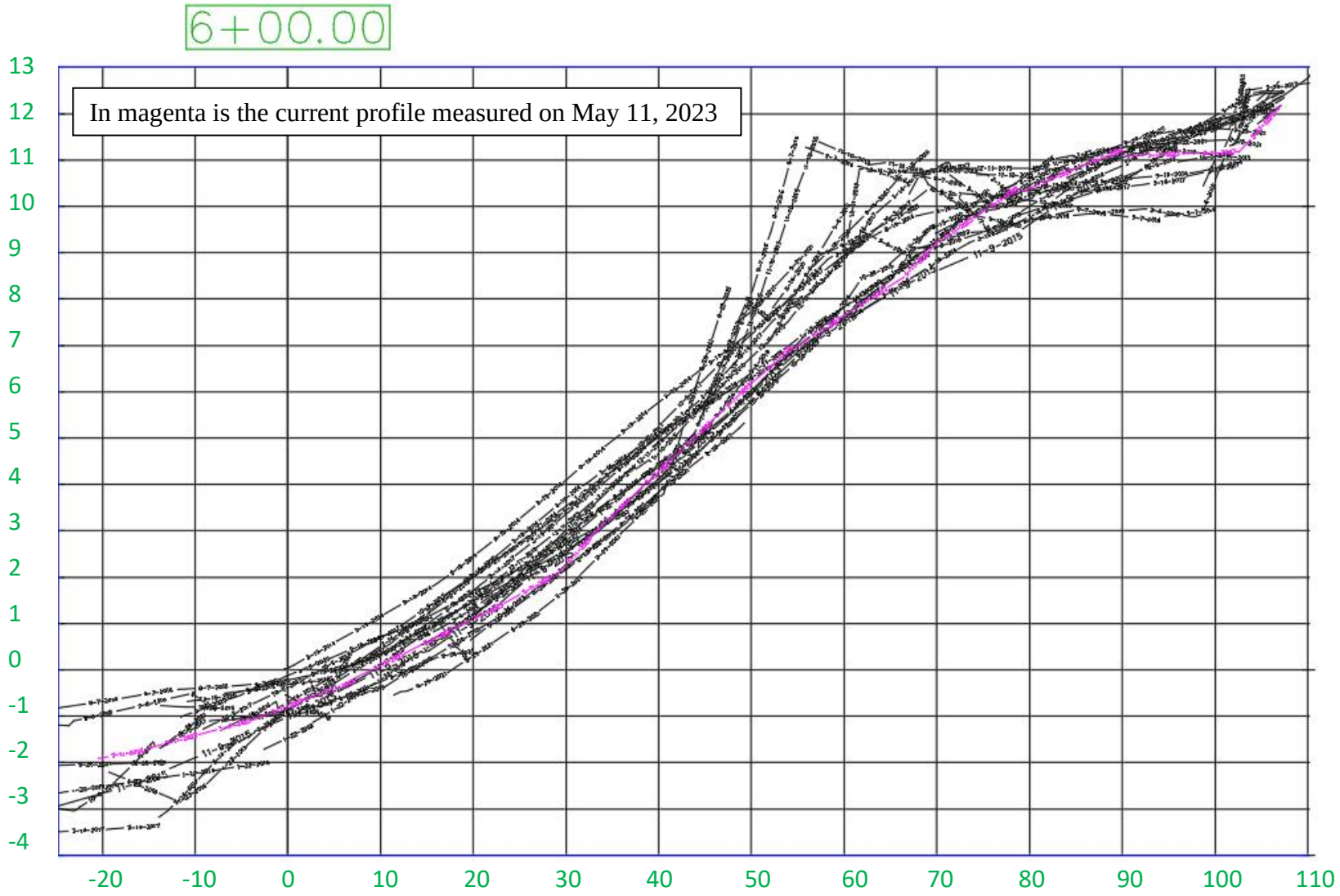


Figure 1-6. Topographic profiles at center of Sugar Cover over 2014-2023 (LMSL Datum, feet)

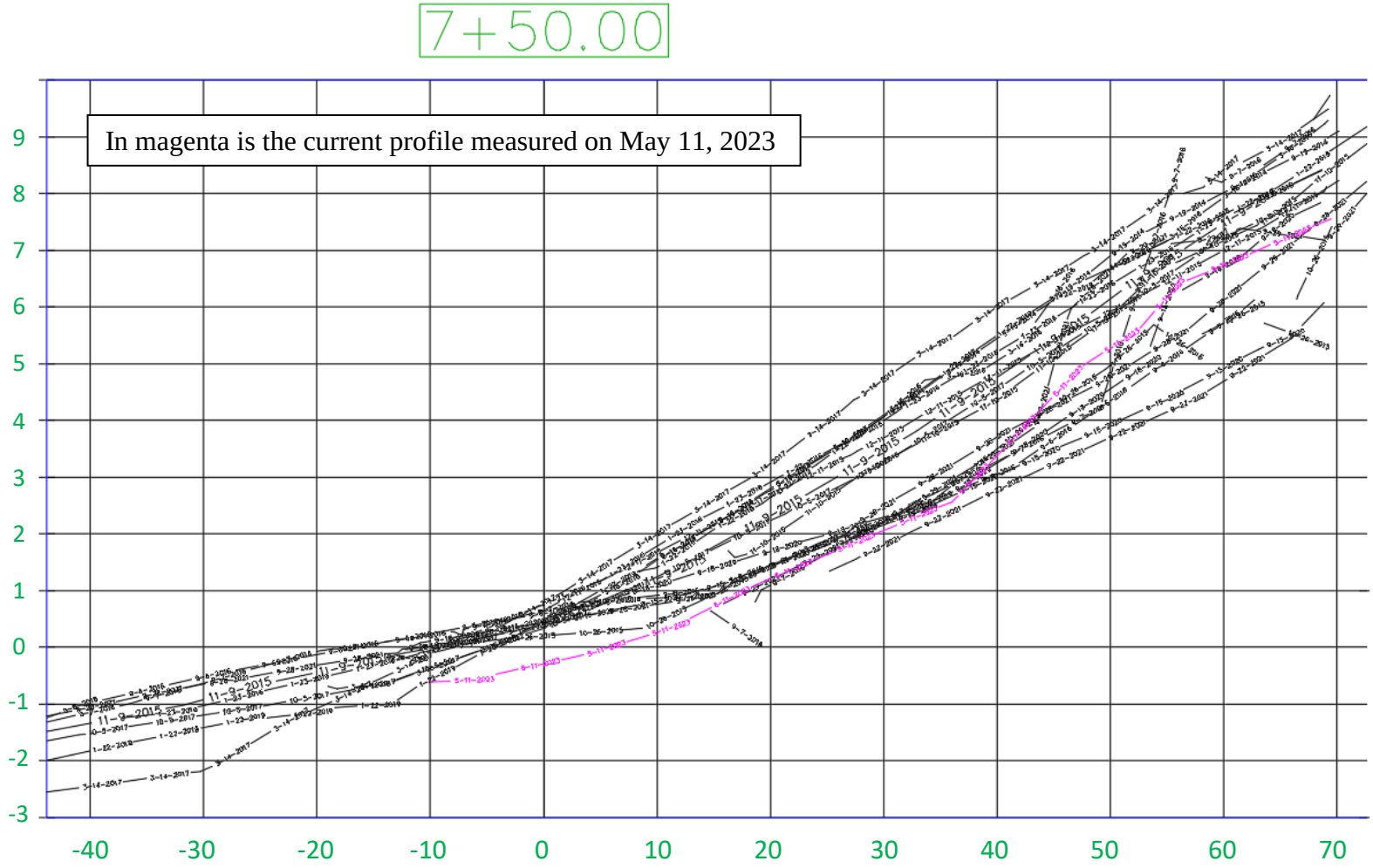


Figure 1-7. Topographic profiles at eastern end of Sugar Cover over 2014-2023 (LMSL Datum, feet)

Figure 1-8. Looking east along the beach, from near the middle of the maintenance area

Figure 1-9. Looking west along the beach, from near the eastern end of the maintenance area

Figure 1-10. Looking inland through the county beach access at the eastern end of the maintenance area

1.5.2 Backshore Conditions

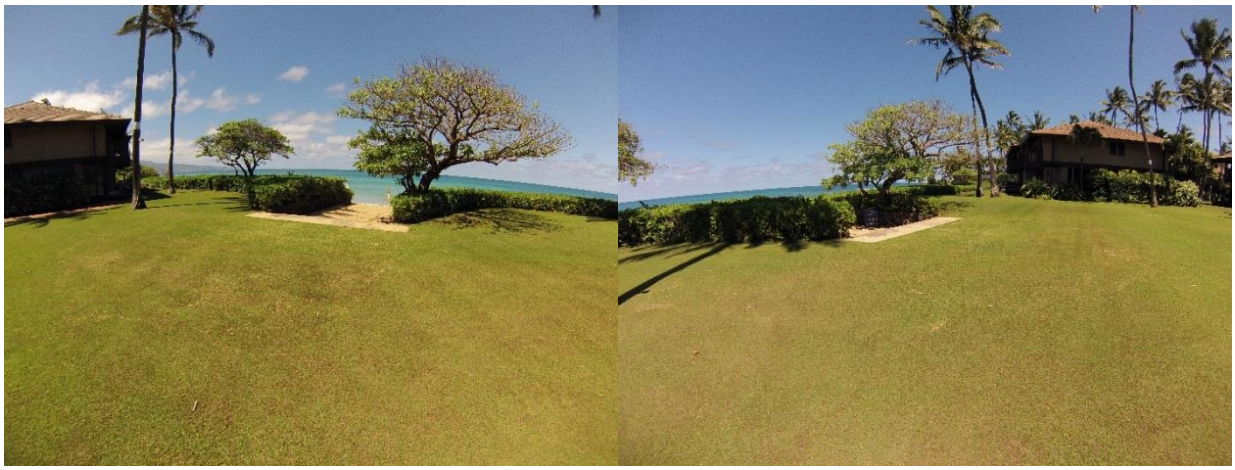


Figure 1-11. Typical backshore conditions at the site

Backshore conditions at the project are typified by a coastal lawn bordered by a naupaka hedge on the makai side. The Hayashi seawall is located beneath and makai of the naupaka hedge, extending seaward beneath the restored sand beach. Dwellings are built in the coastal lawn, adjacent to the mauka side of the Hayashi seawall.

2. BERM MAINTENANCE PLAN

2.1 Purpose

Shoreline restoration and ongoing maintenance have been a necessary activity along the coastline fronting Sugar Cove since the loss of the natural beach. The absence of a natural beach since 1989 indicates that the physical factors controlling beach stability are working in opposition to maintenance efforts. If a long-term sandy coast is desired, the restored berm would require continued placement of sand, high on this erosion prone shoreline.

The unique setting and conditions at Sugar Cove provide a rare opportunity to merge public and private interests; utilizing private funds to sustain public trust lands. All maintenance activities and costs, borne solely by the Association, have resulted in a publicly accessible and widely used sandy shoreline with a County beach access at the eastern end.

Restoration of the sandy ecosystem has wide spread environmental benefits. The north shore of Maui is rapidly losing sandy shorelines and nearshore sandy substrate. These sandy areas are important to green sea turtles, hawksbill turtles, monk seals, shorebirds, and host of other native and endemic coastal fauna.

2.2 Project Scope

The approved berm maintenance plan incorporates all the previous profile and restoration effort data as well as modern conditions for site evaluation and quantification of the successful ongoing coastal restoration and maintenance program. The plan identifies key thresholds for the ongoing maintenance of the berm and target volumes and profiles for placement of beach-quality fill material.

Ongoing maintenance necessitated the development of a monitoring plan that can be used for adaptive management. Water quality (turbidity) monitoring, visual and photographic assessments of the beach, water, and marine environment, and continuation of the ongoing beach profiling effort are all part of the monitoring effort. Each cycle of maintenance activity would be approved by the Office of Conservation and Coastal Lands (OCCL) for sand quality and placement design prior to the commencement of maintenance activities.

2.3 Environmental Considerations

Sandy coastlines are inherently dynamic environments. Beach health, as quantified by volume, slope, and position, is controlled by numerous factors, both natural and anthropogenic. The dominant factors are total water level, wave environment, and available sediment volume within the littoral cell, or sand cell. An additional and key factor in this project is the character of the inland substrate.

2.4 Berm Maintenance Plan

Berm maintenance efforts are designed to sustain a stable littoral cell volume through the programmatic placement of beach-quality fill sand. The design placement area and volumes balance the natural erosive forces acting upon the coastline, preventing a drawdown of beach

profiles and shoreline recession along the beach face. In the beach's current, restored condition, much of the ongoing littoral cell volume loss is from chronic erosion in the upper berm area, inland of the berm crest at the top of the foreshore slope.

2.4.1 Maintenance Design

The maintenance program places beach quality fill sand high on the beach profile, to augment the overwash berm that rests against and atop the Hayashi seawall. The 0-foot contour should remain stable if sufficient sand is supplied to protect the dry beach during wave events. This would minimize the sand volume lost to offshore currents.

Beach quality fill sand placement is designed to be from the +5-foot contour to the backstop of the seawall (Figure 2-1). Fill material would grade upward at a 1V:3H slope from the +5-foot contour to +12 feet, and then extend inland until intersecting the backstop. Profiles illustrate the typical fill material placement location high on the beach profile (Figure 2-2).

This placement, high on the beach profile and well above tidal influence, would significantly improve residence time, while also minimizing losses to wave action.

2.4.2 Volume and Frequency

Fill volumes are designed based on the previous restoration efforts in 2011 that placed nearly 1,250 cy of beach-quality sand at Sugar Cove. The 2011 effort lasted approximately 3 years before berm deflation began to threaten the stability of the 0-foot contour location. Though much of the sand was distributed along the berm and beach face, a portion of the placed sand was incorporated in the nearshore sand bar and assisted with stabilization of the nearshore sand field.

The ongoing goal is to provide enough sediment to allow for maintenance of the berm's elevation, while minimizing loss and maximizing residence time. A volume of roughly 1,000 cy of sand would be sufficient for conducting routine berm maintenance. Extreme wave events or phenomena such as tsunamis, hurricanes, or high elevation mesoscale eddies may result in an accelerated schedule due to episodic erosion events. In addition, the prolonged break in berm maintenance since the previous 2011 effort may require shorter maintenance cycles at the beginning of the plan.

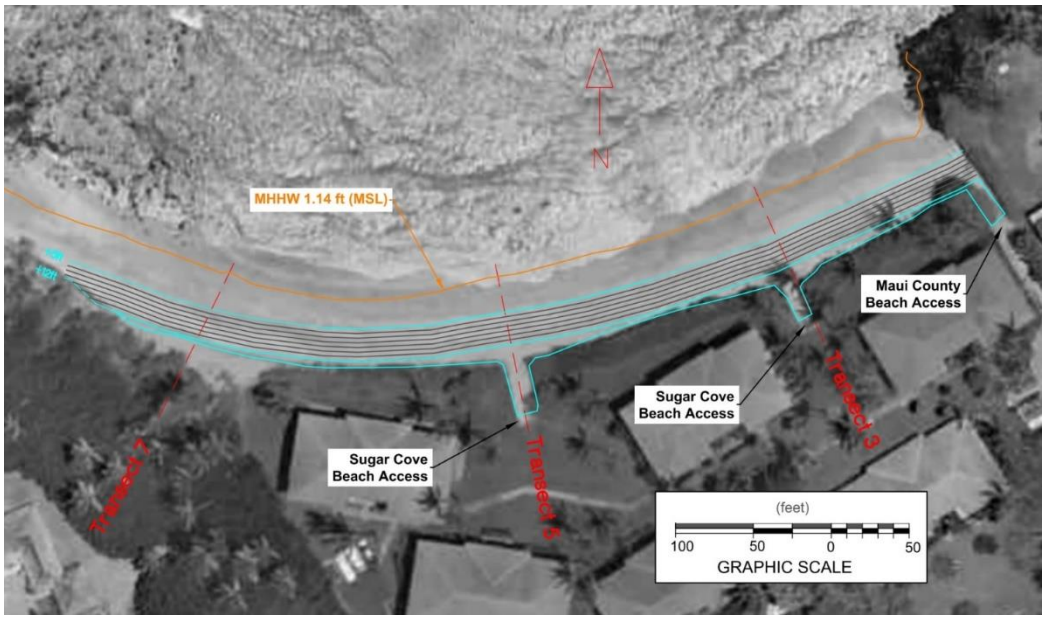


Figure 2-1. Typical berm maintenance location and contours (LMSL Datum)

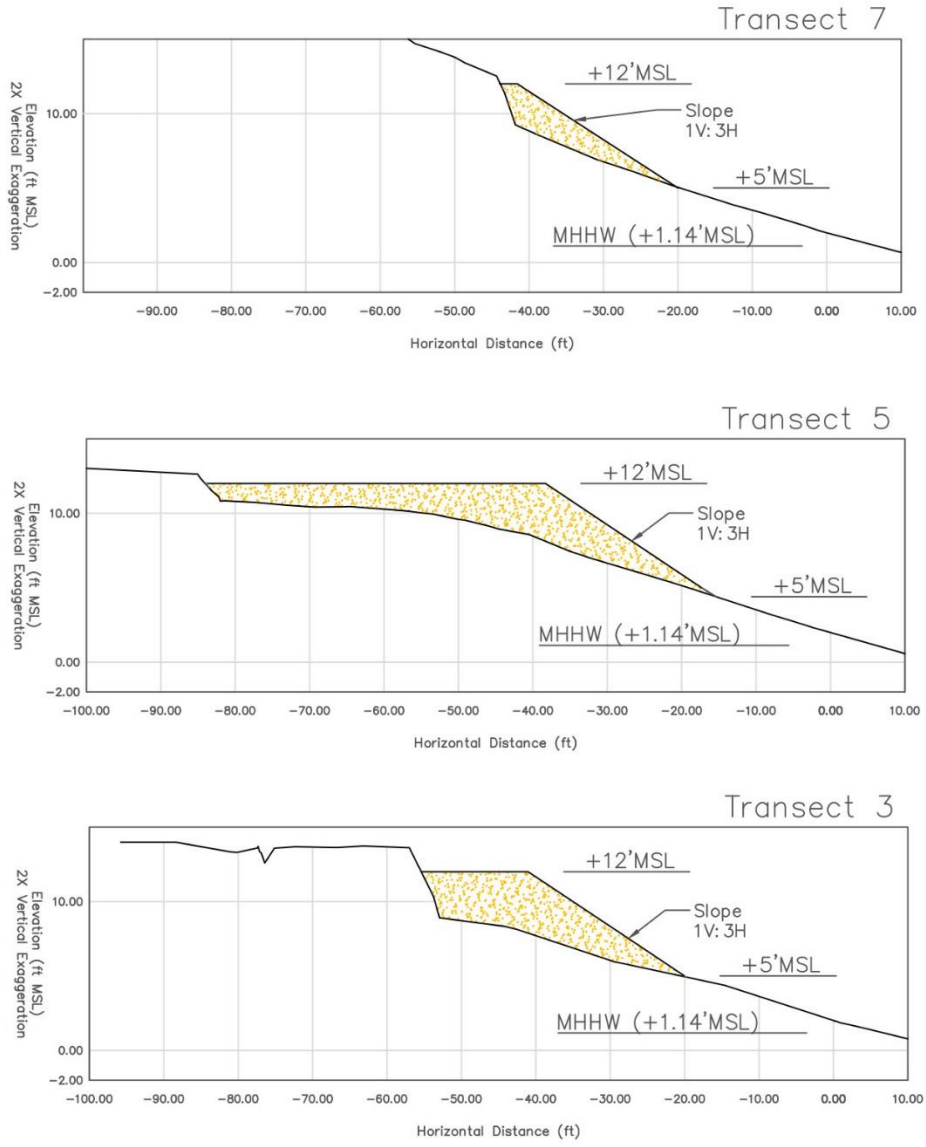


Figure 2-2. Typical berm maintenance profiles (LMSL Datum)

2.4.3 Physical Triggers for Maintenance

Berm deflation is the primary physical trigger for identifying when to conduct routine volume maintenance efforts. As a general indicator, when the seaward portion of the berm and berm crest are at an elevation close to or below +10 feet in elevation, the next maintenance effort should be conducted. At that time approximately 1,000 cy of beach quality sand should be added to the upper portion of the profile, during the maintenance effort.

Long-term stability of the beach would continue to be monitored using the relative location of the 0-foot contour to the seawall. Transect 5, located in the center of the beach and affected the least by seasonal wave climates, is an appropriate location to monitor this beach width indicator. In the

event that the 0-foot contour begins to migrate inland, maintenance should be conducted as quickly as possible. An approximate volume of 3,500 cubic yards should be added, extending from the +2.5-foot contour to +12 feet, for rapid stabilization of the beach system, or several 1,000 cy efforts should be conducted over a one-year period.

2.4.4 Typical Equipment List for Maintenance

Level, Total Station, and/or RTK Survey System – for elevations
Dump truck(s) – for sand delivery
Bulldozer – for sand placement and grading

2.4.5 Description of Maintenance Work

The maintenance work is simple in nature and consists of delivery and grading of beach quality fill sand on the upper portion of the profile. Each maintenance cycle would require a single work day for placement and grading of beach quality fill sand on the beach berm. Maintenance activities would be conducted as follows:

- The 5-foot contour would be identified and marked on the foreshore.
- Silt booms or fence would be placed on the makai side of the 5-foot contour.
- Dump trucks would bring the material to the western side of the Association's property, and place the sand directly onto the beach berm, makai of the erosion scarp.
- Ingress and egress of machinery would be along the western side of the property. Equipment would be brought onto the site through the parking lot, and material would be transferred to the beach at the western end of the project site. Equipment would transit across the property, to the beach.
- There would be no stockpiling or equipment storage on the property.
- A bulldozer, similar in size to a D-5, would transit across the property to the beach berm and would remain on the beach throughout the day while spreading sand. The bulldozer would spread the sand from the west to the east, as the dump trucks are delivering the material directly to the beach berm.
- Contemporaneous delivery and spreading of the material would minimize the area needed to transfer the material directly onto the berm.
- The bulldozer would also push sand mauka within the Association's access paths, and the County access if appropriate.
- Some fill material may be delivered through the County access for distribution at the eastern end of the berm, if appropriate. This sand would also be placed directly on the beach berm.
- The makai face of the fill material would be graded to a 1V:3H slope.
- The surface of the material would be back bladed to leave the fill material available for immediate use.
- Silt fences and the markings for the 5-foot contour would be removed.
- Each maintenance action, placing roughly 1,000 cubic yards and grading to specifications on the berm, would be completed within a single work day.

3. ADAPTIVE MANAGEMENT PLAN

This plan establishes a programmatic, managed approach that allows for ongoing monitoring and adaptive management. The 10-year lifespan of the management plan, covering multiple berm maintenance efforts requires ongoing monitoring of beach face and nearshore elevations, review of berm fill sand prior to each placement, review of the placement plan prior to each effort, monitoring of each effort both during and after placement, and environmental monitoring to include water turbidity monitoring, benthic photographic documentation, and marine and coastal environmental photographs.

3.1 Adaptive Management Goals

The adaptive management plan would review each previous effort for the following:

- Quality of placed material, after placement
- Observed beach and ocean conditions
- Beach profile adjustments
- Maintenance activity lifecycle

The plan would use the data collected to quantify and qualify the effectiveness of material placement during each berm maintenance cycle, and the material's impact, or lack thereof, on the environment.

3.2 Management Team

The management team would consist of the following:

- A Sugar Cove AOAO representative
- A technical consultant
- A representative from the Office of Conservation and Coastal Lands

Recommended team members to include:

- Sea Grant Extension Agent positioned with the Maui County Planning Department

3.3 Management Tasks

Quality of Placed Material

Prior to each maintenance effort, grain size analysis of the beach-quality sand proposed for use would be provided to the OCCL for review. OCCL would review the proposed sand under the existing SSBN sand source guidelines. OCCL sand source approval would be required prior to initiating each maintenance effort.

Six months after placement, a composite sand sample from the berm would be analyzed for grain size distribution. These data would be compared to the pre-placement beach sample and berm maintenance fill sand sample data to document any changes in character to the beach sand.

Observed Coastal and Marine Environmental Conditions

Conditions would be documented through photographs of the nearshore waters, nearshore substrate characteristics, the location of the shoreline, and general condition of the beach and

backshore. Photographs would be collected from along each of the three transects and across the cove from each end of the beach. These photographs would be collected just prior to the start of each effort, during placement, and after placement. Additional photographs would be collected during each beach profile effort.

In addition, water quality data would be collected during monitoring activities and provided as a quantitative evaluation of conditions at Sugar Cove and local control sites. Water quality data would consist of turbidity measurements and documented environmental conditions. Two control sites have been identified in analogous coastal environments to the east and west of Sugar Cove.

Figure 3-1 identifies the locations of each water quality sample station. Each sample station is located approximately 150 feet from the waterline. Control Station East is located at Baldwin beach, approximately 0.65 miles east of the project site station. Sugar Cove Station is located in the middle of the project beach. Control Station West is located at Spreckelsville Beach, approximately 0.45 miles west of the project site station.

Figure 3-1. Water quality monitoring stations for turbidity sample collection

Beach Profile Adjustments

Beach profiles would be collected before and after each placement and continuing on with the semi-annual schedule. These beach profile data would be collected at the three previously identified locations. Data would be added to the long-term record for review and analysis.

Maintenance Activity Lifecycle
The project would be reviewed prior to each berm maintenance effort to assess the duration of previous berm maintenance actions, with respect to the beach-quality sand augmenting the dry beach volume and profile.

Effectiveness of Material Placement
Each placement would be photographed to document beach conditions prior to placement, during placement, immediately after placement, and semi-annually after placement. Photographs would be taken along each of the transect locations and looking in multiple directions, to capture existing beach conditions.

Review
Data from each of these tasks, combined with the photograph sets, would be reviewed prior to the next berm maintenance effort. Each review would detail potential erosion events, such as extreme waves, storms, or tsunamis, which may have impacted the shoreline. Each review would discuss the volume placed, starting and ending profiles, environmental conditions including both nearshore and beach areas, water quality as documented through turbidity sample data collection, and berm maintenance material characteristics from previous efforts. Each review would also revisit alternative measures to assess their viability under current conditions.

3.4 Management Decisions

The maintenance program would place beach quality fill sand high on the beach profile, to augment the overwash berm that rests against and atop the Hayashi seawall. The 0-foot contour should remain stable if sufficient sand is supplied to protect the dry beach during wave events. This would minimize sand volume lost to offshore currents.

Physical Triggers for Berm Maintenance:
Berm deflation is the primary physical trigger for identifying when to conduct routine volume maintenance efforts. As a general indicator, when the seaward portion of the berm and berm crest are at an elevation close to or below +10 feet in elevation, the next maintenance effort should be conducted. At that time approximately 1,000 cy of beach quality sand should be added to the upper portion of the profile, during a single day maintenance effort.

Additional triggers are beach width and beach slope at Transect 5. Transect 5 is the least affected transect by the seasonal changes in winter and summer and is the good indicator of long-term changes in the littoral cell. Beach width, measured at the 0-foot contour, at Transect 5 routinely returns to 100 feet from the profile's reference point, and is increasing stable at that width with the gradual, cumulative increase in littoral cell sediment. An additional trigger would be when the 0-foot contour narrows to less than 100 feet from the Transect 5 reference point. Berm deflation is typically coupled with flattening of the foreshore slope. A return of the foreshore slope to between 1V:6H to 1V:8H is another physical trigger that would indicate a need for future maintenance actions.

Ensuing Berm Maintenance Design:

The management team would review existing data from the previous berm maintenance effort(s), prior to the next effort to determine if the design and materials are within the scope of this management plan and the Small-Scale Beach Nourishment program. The management team would determine if the previous effort(s) were successful in design and implementation. They would review the maintenance effort design and materials, with respect to the previously collected data sets, including the history of environmental conditions from the previous effort(s). Specifically, the berm maintenance sand would be evaluated based on the requirements within the SSBN program and past performance of the material, if applicable, when used for berm maintenance.

If the team determines that alteration(s) are needed for the upcoming berm maintenance effort, and these alterations can be supported by the existing data, then the design and materials would be adapted as needed.

4. BERM MAINTENANCE EFFORT #1 – WINTER 2015

This berm maintenance effort was conducted over a day and a half, from the morning of November 9 to mid-day on November 10, 2015. Delays due to traffic conditions and slow turn around at the sand source required additional work on the second morning.

4.1 Maintenance Plan Parameters

Trigger: The berm elevation at Transect 5 was deflated to below the trigger elevation of +10 feet. The berm had been below the trigger elevation since before the initial submission of the SSBN application in August of 2014. During the interim period between initial submission of the application and placement of the maintenance sand during the first effort in November of 2015, there were numerous large wave events and several small tsunamis, each of which further deflated the beach face.

Sand Source: Ameron Maui Dune Sand was used for the maintenance effort, as was approved with SSBN MA-15-02. Calculations based off of existing and maintenance sand grain size analysis indicate that an overfill factor of 1.26 may be needed for the maintenance sand.

Volume: The recommended volume for each maintenance event is 1,000 cubic yards of placed sand. Maintenance operations resulted in the placement of 1,205 tons of sand on the beach, including 60 tons of sand in the County of Maui beach access path. Using a conversion factor of 1.35 tons per cubic yard results in 892 cubic yards of sand placed, with nearly 45 cubic yards of sand placed in the access path.

4.2 Maintenance Sand Placement

Delivery Method: Tavares Trucking utilized four vehicles to maintain a consistent delivery pace. Morning and afternoon delivery speeds were negatively impacted by local traffic issues. Truck delivery of sand to the berm was at the west end of the embayment, through the Sugar Cove property to the public beach. A small gap was cut into the sand bank (Figure 4-1) allowing the trucks to deliver sand directly to the berm. Truck delivery of sand to the County of Maui beach access utilized a smaller truck and delivered sand directly to the beach access from the street (Figure 4-2).

Placement: A single operator, contracted by Tavares Trucking, used a Caterpillar D4G bulldozer (Figure 4-3) to move sand along the berm and shape the new sand bank (Figure 4-4). Sand pushing and grading were completed from west to east along the berm. All sand moving and grading was conducted on the berm, makai of the shoreline vegetation and well inland from mean higher high water. The maintenance sand berm abutted the boulders and sand bank on the mauka side and extended from the west end of the property to Transect 3. The low elevation of the existing berm prevented placement of the maintenance sand between Transect 3 and the County of Maui beach access path (Figure 4-5). Sand placed within the County of Maui beach access was brought in from the street and pushed down the beach access by the Caterpillar operator.

Final Grade: The upper portion of the berm maintenance sand was placed atop the low elevation berm (Figure 4-6) on the beach profile, and was graded to a nearly horizontal plane (Figure 4-7).

The makai face of the material was graded to as gentle a slope as was possible, given the already deflated and narrow beach profile. 60 ton of sand was placed in the County of Maui beach access to cover the pre-existing irregular grade (Figure 4-8), including a 3-foot-tall ledge (Figure 4-9). The final grade in the access was a smooth slope from the top of the access path to the beach berm (Figure 4-10).

Figure 4-1. Sand delivery to the west end of the cove for placement on the berm (Maintenance #1)

Figure 4-2. Smaller dump truck delivering sand to the County of Maui beach access path (Maintenance #1)

Figure 4-3. Bulldozer spreading sand along the berm (Maintenance #1)

Figure 4-4. Sand grading on the berm (Maintenance #1)

Figure 4-5. Graded sand with finished makai slope and silt fencing ending near Transect 3 (Maintenance #1)

Figure 4-6. Beach condition prior to placement (November 9, 2015, Maintenance #1)

Figure 4-7. Beach and berm condition after placement (November 10, 2015, Maintenance #1)

Figure 4-8. County of Maui beach access path prior to sand placement (Maintenance #1)

Figure 4-9. Three-foot scarp in County of Maui beach access path (Maintenance #1)

Figure 4-10. County of Maui beach access path with graded maintenance sand (Maintenance #1)

4.3 Maintenance #1 Environmental Conditions

Environmental observations were collected routinely before, during, and after project operations.

Tides: Spring tides with the new moon were highest during the night with lower low tides in the morning (Figure 4-11). Both days had morning lows around 0 feet MLLW and mid-afternoon lower highs of less than 2 feet MLLW. The maintenance activity schedule ensured that placement and grading operations were generally during lower tides. There were no mesoscale eddies or other significant factors that effected the total water level.

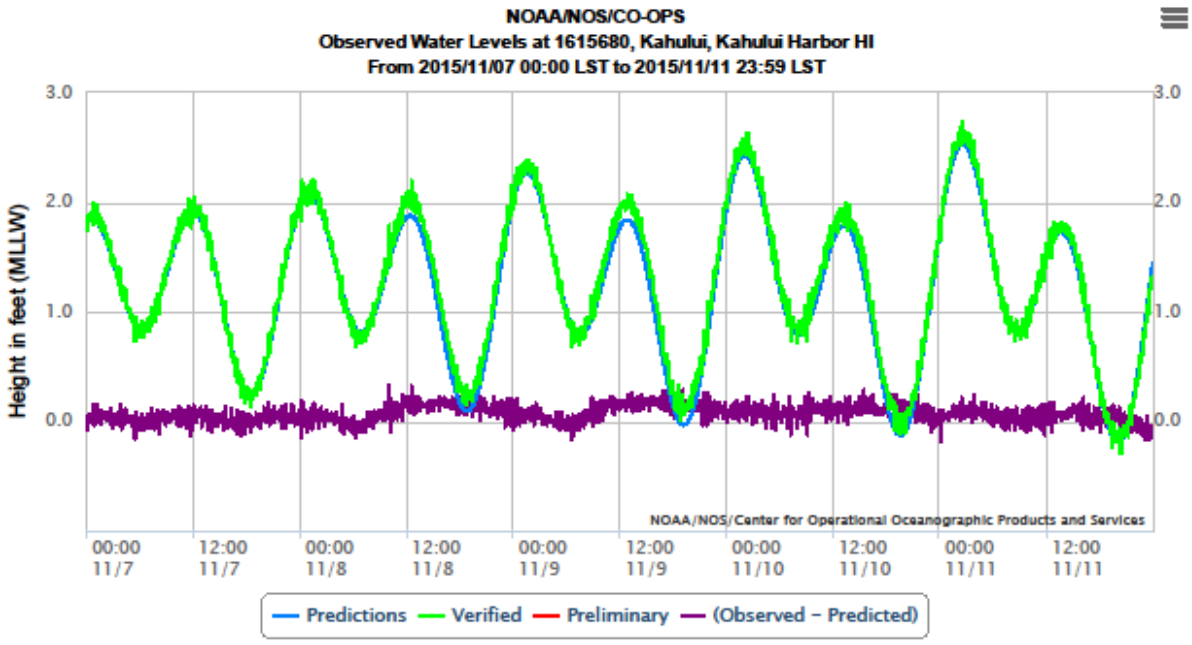


Figure 4-11. Water levels near the project site during maintenance #1

Waves: Waves at the offshore buoy, located at Pauwela, Maui, recorded moderately large waves directly before and on the first day of the project (Figure 4-12). This large east swell was impacting the region for several days before and during the first day of placement. The month of November 2015 had several periods of large waves immediately following the maintenance effort. Wind waves along the coastline were well developed and present for the duration of the project. During placement, observations of wave face heights at the reef crest directly offshore of the cove and at the sandbar inside the cove were made and are presented in Table 4-1.

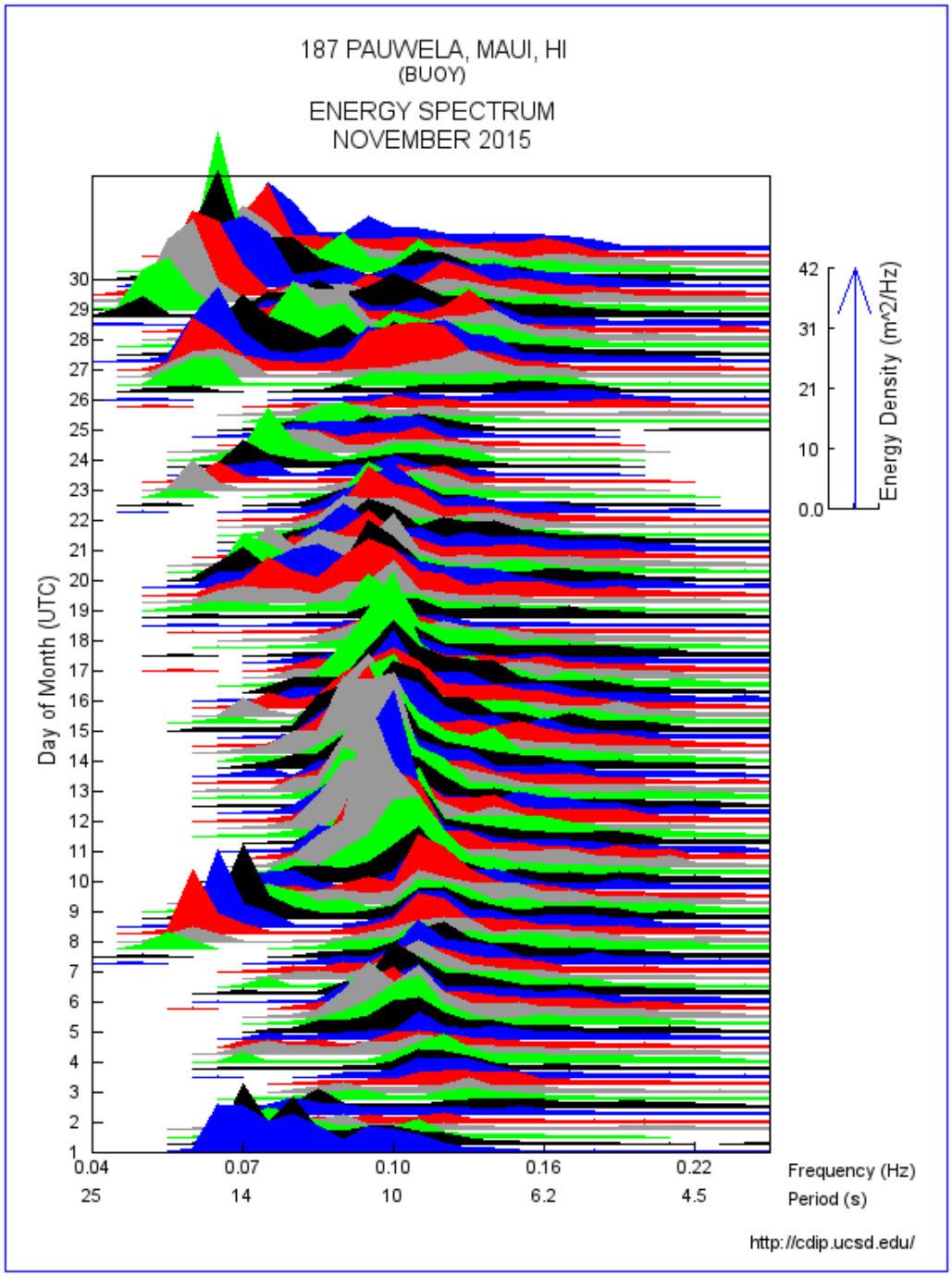


Figure 4-12. Pauwela wave buoy data for November 2015

Table 4-1. Wave observations during maintenance efforts

Date - Time	Reef Crest Wave Height (ft)	Sandbar Wave Height (ft)
2015/11/09 - 0700	4 – 6	2 – 4
2015/11/09 - 1130	4 – 6	2 – 4
2015/11/09 – 1630	4 – 6	2 – 4
2015/11/10 – 0700	4 – 6	2 – 4
2015/11/10 – 0915	4 – 6	2 – 4
2015/11/10 – 1430	4 – 6	2 – 4

Winds: Winds at the project site were high for the duration of the project, with speeds of 15 – 20 miles per hour (mph) and gusts above 30 mph. General wind direction was out of the northeast.

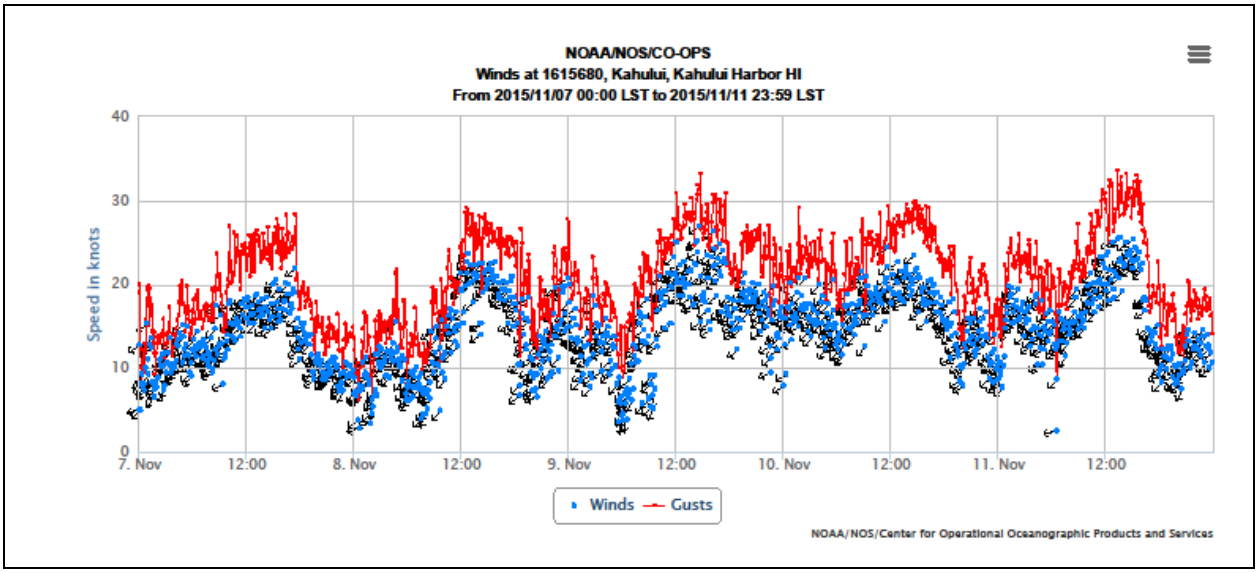


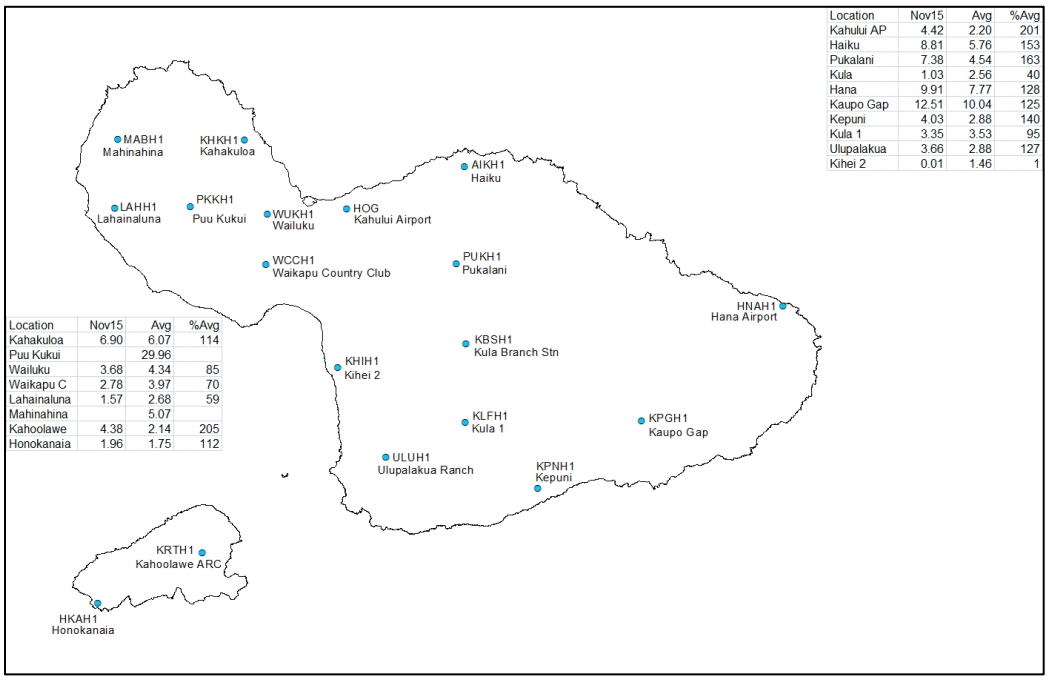
Figure 4-13. NOAA wind data for Kahului Harbor between November 7 and 11, 2015

Table 4-2. Wind observations during maintenance efforts

Date - Time	Winds Speed at Cove
2015/11/09 - 0700	25+ mph
2015/11/09 - 1130	20+ mph
2015/11/09 – 1630	25+ mph
2015/11/10 – 0700	15+ mph
2015/11/10 – 0915	25+ mph
2015/11/10 – 1430	25+ mph

Precipitation: The local area had heavy rains for two days before the project started. The month of November had well above average rainfall (Figure 4-14), with greater than 150% above average

rainfall for the area during the month. Only passing showers were noted during the two days of maintenance efforts.



Location	Nov15	Avg	%Avg
Kahului AP	4.42	2.20	201
Haiku	8.81	5.76	153
Pukalani	7.38	4.54	163
Kula	1.03	2.56	40
Hana	9.91	7.77	128
Kaupo Gap	12.51	10.04	125
Kepuni	4.03	2.88	140
Kula 1	3.35	3.53	95
Ulupalakua	3.66	2.88	127
Kihei 2	0.01	1.46	1

Location	Nov15	Avg	%Avg
Kahakuloa	6.90	6.07	114
Puu Kukui		29.96	
Wailuku	3.68	4.34	85
Waikapu C	2.78	3.97	70
Lahainaluna	1.57	2.68	59
Mahinahina		5.07	
Kahoolawe	4.38	2.14	205
Honokanaia	1.96	1.75	112

Figure 4-14. Regional precipitation from rain gauges on Maui for November 2015 (Maintenance #1)

Marine Species: No endangered or protected marine species were observed during the implementation of the project.

4.4 Maintenance Best Management Practices

All applicable practices within the approved Best Management Practices Plan were adhered to. In particular, these specific practices were important for protecting the environment and the public:

- A silt fence was placed at the base of the slope as the sand was pushed from west to east on the berm.
- All work was conducted above mean higher high water and above the swash zone.
- No equipment was operated in the swash zone.
- Project notification sign was posted at the County of Maui beach access and on the beach (Figure 4-15 and Figure 4-16).
- A permanent project sign has been placed at the mauka end of the County of Maui beach access, on the subject property's wall (Figure 4-17).
- The beach and nearshore waters were inspected prior to initiation of work and throughout the project to ensure that no protected marine species were within 50 yards of the project area.

Figure 4-15. Signage posting within the County of Maui beach access notifying the public of the maintenance activity (Maintenance #1)

Figure 4-16. Close up of the signs posted on the beach and at the access during the project (Maintenance #1)

Figure 4-17. Permanent placard mounted on the wall adjacent to the County of Maui beach access (Maintenance #1)

5. BERM MAINTENANCE EFFORT #2 – FALL 2016

This berm maintenance effort was conducted over September 6-7, 2016.

5.1 Maintenance Plan Parameters

Trigger: The berm elevation at Transect 5 was deflated to below the trigger elevation of +10 feet. The second maintenance effort was undertaken due to the severe impacts of the El Nino winter compounding with the significant time delay between the nourishment effort in 2011 and the first maintenance event in 2015.

Sand Source: Ameron Maui Dune Sand was used for the maintenance effort, as was approved with SSBN MA-15-02. Calculations based off of existing and maintenance sand grain size analysis indicate that an overfill factor of 1.26 may be needed for the maintenance sand.

Volume: The recommended volume for each maintenance event is 1,000 cubic yards of placed sand. Maintenance operations resulted in the placement of 1,505.25 tons of sand on the beach. Using a conversion factor of 1.35 tons per cubic yard results in 1,115 cubic yards of sand placed.

5.2 Maintenance Sand Placement

Delivery Method: Tavares Trucking utilized four vehicles to maintain a consistent delivery pace. Truck delivery of sand to the berm was at the west end of the embayment, through the Sugar Cove property to the public beach. A small gap was cut into the sand bank (Figure 4-1, Figure 5-1) allowing the trucks to deliver sand directly to the berm.

Placement: A single operator, contracted by Tavares Trucking, used a Caterpillar D4G bulldozer (Figure 5-2) to move sand along the berm and shape the new sand bank. Sand pushing and grading were completed from west to east along the berm. All sand moving and grading was conducted on the berm, makai of the shoreline vegetation and well inland from mean higher high water. The maintenance sand berm abutted the boulders and sand bank on the mauka side, and extended from the west end of the property to Transect 3 where the erosion was too severe for the bulldozer to spread sand without entering the water (Figure 5-3). No sand was added to the access path because it was still full. Too much sand on the path would make it too steep of a slope.

Final Grade: The upper portion of the berm maintenance sand was placed atop the low elevation berm (Figure 5-4) on the beach profile and was graded to a nearly horizontal plane (Figure 5-5). The makai face of the material was graded to as gentle a slope as was possible, given the already deflated and narrow beach profile.

Figure 5-1. Dump truck delivering sand to the west end of the cove for placement on the berm (Maintenance #2)

Figure 5-2. Bulldozer spreading sand along the berm (Maintenance #2)

Figure 5-3. Graded sand with finished makai slope and silt fencing ending near Transect 3 (Maintenance #2)

Figure 5-4. Beach condition prior to placement on September 6, 2016 (Maintenance #2)

Figure 5-5. Beach and berm condition after placement on September 7, 2016 (Maintenance #2)

Figure 5-6. County of Maui beach access path during sand placement (Maintenance #2)

5.3 Maintenance #2 Environmental Conditions

Environmental observations were collected routinely before, during, and after project operations.

Tides: Tides were highest during the night with lower low tides in the morning (Figure 5-7). Both days had morning lows around 0.8 feet MLLW and mid-afternoon lower highs of less than 2.2 feet MLLW. The maintenance activity schedule ensured that placement and grading operations were

generally during lower tides. There were no mesoscale eddies or other significant factors that effected the total water level.

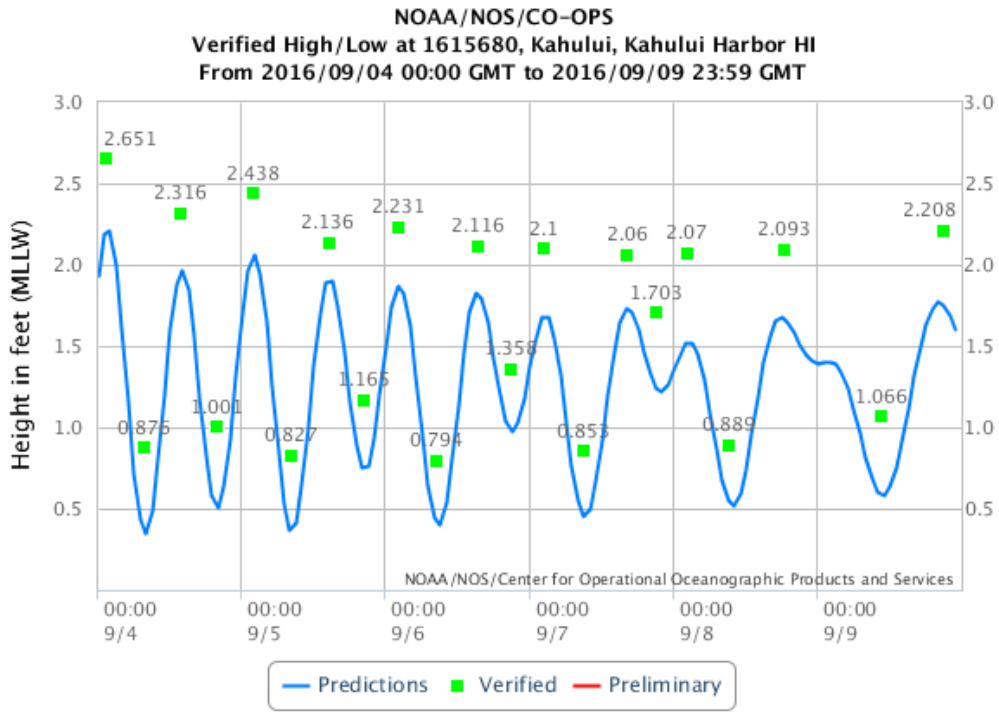


Figure 5-7. Observed water levels during the sand placement (Maintenance #2)

Waves: Waves at the offshore buoy, located at Pauwela, Maui, recorded moderately large waves directly before the first day of the project (Figure 5-8). This large east swell was impacting the region for several days before and during the first day of placement. Wind waves along the coastline were well developed and present for the duration of the project. During sand placement, observations of wave face heights at the reef crest directly offshore of the cove and at the sandbar inside the cove were made and are presented in Table 5-1.

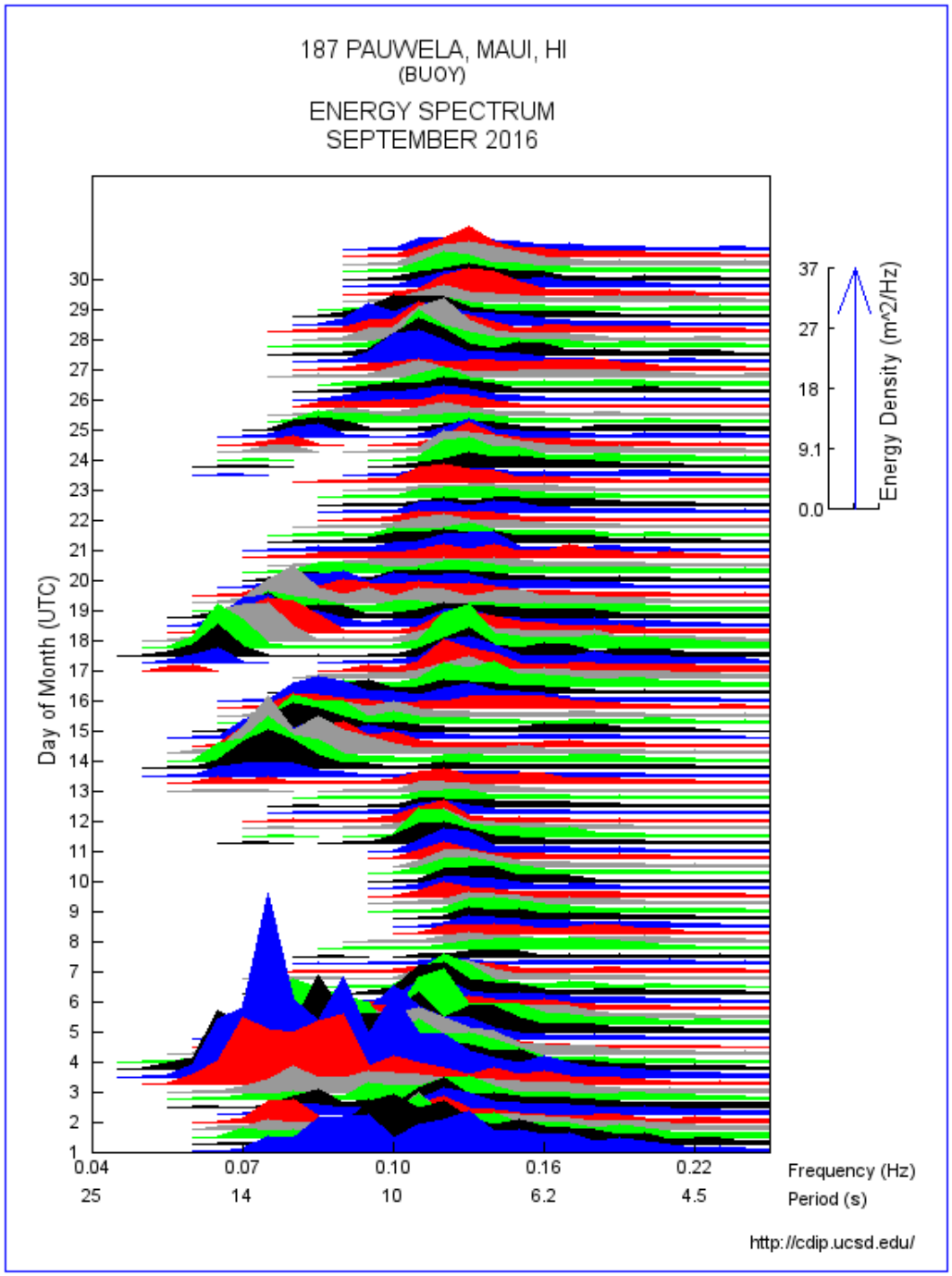


Figure 5-8. Pauwela wave buoy data for September 2016 (Maintenance #2)

Table 5-1. Wave observations during maintenance efforts

Date - Time	Reef Crest Wave Height (ft)	Sandbar Wave Height (ft)
2016/09/06 0700	0	1-1.5
2016/09/06 1115	0	1-1.5
2016/09/06 1750	0	1-1.5
2016/09/07 0700	0	1
2016/09/07 1200	0	1-1.5
2016/09/07 1320	0	1-1.5
2016/09/07 1630	0	1-2

Winds: Winds at the project site were high for the duration of the project, with speeds of 15 – 20 miles per hour (mph) and gusts above 25 mph. General wind direction was out of the northeast.

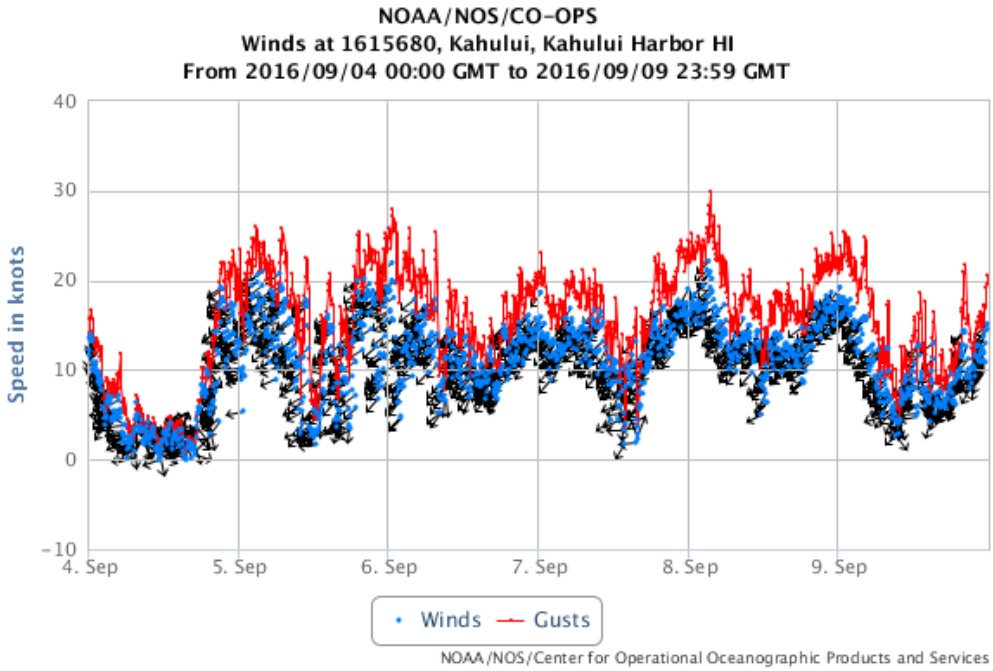


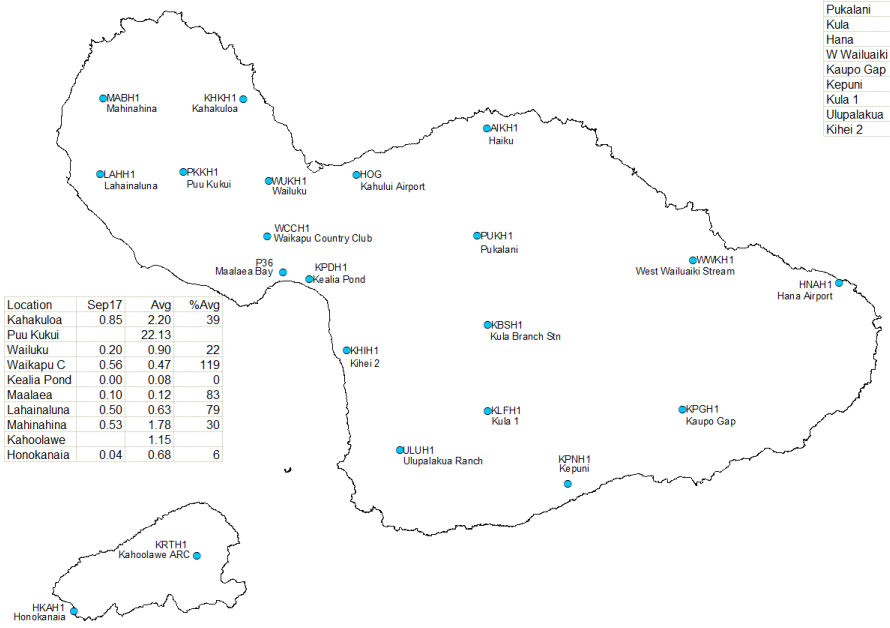
Figure 5-9. NOAA wind data for Kahului Harbor between September 6 and 7, 2016 (Maintenance #2)

Table 5-2. Wind observations during maintenance efforts

Date - Time	Winds Speed at Cove (mph)
2016/09/06 0700	10-12 ENE
2016/09/06 1115	14-17 ENE
2016/09/06 1750	15-20 ENE
2016/09/07 0700	12-15 ENE
2016/09/07 1200	14-17 ENE
2016/09/07 1320	15-20 ENE
2016/09/07 1630	20-30 ENE

Precipitation: The month of September had above average rainfall for the month in some areas, but only 16-47% of the average near the project site (Figure 4-14).

Location	Sep17	Avg	%Avg
Kahului AP	0.06	0.38	16
Haiku	1.13	2.38	47
Pukalani	0.30	1.46	21
Kula	0.78	1.15	68
Hana		6.82	
W Wailuaiki	7.97	14.19	56
Kaupo Gap		4.36	
Kepuni	1.13	0.96	118
Kula 1	0.68	2.04	33
Ulupalakua	0.95	2.00	48
Kihei 2		0.27	



Location	Sep17	Avg	%Avg
Kahakuloa	0.85	2.20	39
Puu Kukui		22.13	
Wailuku	0.20	0.90	22
Waikapu C	0.56	0.47	119
Kealia Pond	0.00	0.08	0
Maalaea	0.10	0.12	83
Lahainaluna	0.50	0.63	79
Mahinahina	0.53	1.78	30
Kahoolawe		1.15	
Honokanaia	0.04	0.68	6

Figure 5-10. Regional precipitation from rain gauges on Maui for September 2016 (Maintenance #2)

Marine Species: No endangered or protected marine species were observed during the implementation of the project.

5.4 Maintenance Best Management Practices

All applicable practices within the approved Best Management Practices Plan were adhered to. In particular, these specific practices were important for protecting the environment and the public:

- A silt fence was placed at the base of the slope as the sand was pushed from west to east on the berm.
- All work was conducted above mean higher high water and above the swash zone.
- No equipment was operated in the swash zone.
- Project notification sign was posted at the County of Maui beach access and on the beach.
- The beach and nearshore waters were inspected prior to initiation of work and throughout the project to ensure that no protected marine species were within 50 yards of the project area.

6. BERM MAINTENANCE EFFORT #3 – FALL 2020

This berm maintenance effort was originally scheduled for September 2017, but was not conducted due to local issues with the sand source. In June of 2020 a new sand source, Pacific Aggregate LLC "Natural Sand Blended", was found and approved for berm maintenance at Sugar Cove. It is calcium carbonate mined from an inland quarry, which is screened and triple-washed. It is not crushed limestone. The third maintenance effort occurred on September 16, 2020.

6.1 Maintenance Plan Parameters

Trigger: The berm elevation at Transect 5 was deflated to below the trigger elevation of +10 feet.

Sand Source: Pacific Aggregate LLC "Natural Sand Blended" was used for the maintenance effort, as was approved with SSBN MA-15-02. The slightly coarser sand is expected to have a longer residence time on the beach than that for previous nourishment efforts, particularly since the smaller grain size range ($< D_{50}$) is coarser.

Volume: The recommended volume for each maintenance event is 1,000 cubic yards of placed sand. Maintenance operations resulted in the placement of 1,000 tons of sand on the beach. Using a conversion factor of 1.35 tons per cubic yard results in 740 cubic yards of sand placed.

6.2 Maintenance Sand Placement

Delivery Method: The sand was first shipped from Oahu to Maui on a barge and arrived on September 15, 2020. From Kahului Harbor, Gnomes Trucking and Tavares Trucking utilized vehicles to maintain a consistent delivery pace of about 12 trucks per hour for a total of about 60 truckloads between 0730 and 1300. Road work on Hana Highway slowed down the truck turnover. Truck delivery of sand to the berm was at the west end of the embayment, through the Sugar Cove property to the public beach. A small gap was cut into the sand bank (Figure 4-1, Figure 5-1) allowing the trucks to deliver sand directly to the berm.

Placement: Two operators, contracted by Tavares Trucking, used two Caterpillar D4G bulldozer (Figure 5-2) to move sand along the berm and shape the new sand bank. Sand pushing and grading were completed from west to east along the berm. All sand moving and grading was conducted on the berm, makai of the shoreline vegetation and well inland from mean higher high water. The maintenance sand berm abutted the boulders and sand bank on the mauka side, and extended from the west end of the property to Transect 3 where the erosion was too severe for the bulldozer to spread sand without entering the water (Figure 5-3). No sand was added to the access path because it was still full. Too much sand on the path would make it too steep of a slope.

Final Grade: The upper portion of the berm maintenance sand was placed atop the low elevation berm (Figure 5-4) on the beach profile and was graded to a nearly horizontal plane (Figure 5-5). The makai face of the material was graded to as gentle a slope as was possible, given the already deflated and narrow beach profile.

Figure 6-1. Dump truck delivering sand to the west end of the cove for placement on the berm (Maintenance #3)

Figure 6-2. Bulldozer spreading sand along the berm (Maintenance #3)

Figure 6-3. Graded sand with finished makai slope and silt fencing ending near Transect 3 (Maintenance #3)

Figure 6-4. Beach and berm condition after placement on September 7, 2016 (Maintenance #2)

Figure 6-5. County of Maui beach access path during sand placement (Maintenance #2)

6.3 Maintenance #3 Environmental Conditions

Environmental observations were collected routinely before, during, and after project operations.

Tides: Tides were highest in the afternoon with lower low tides in the morning (Figure 5-7). Morning lows were 0.47 feet MLLW and the afternoon was 3.3 feet MLLW. The maintenance activity schedule ensured that placement and grading operations were generally during lower tides. There was an anticyclonic warm core eddy to the north of the project area during sand placement resulting in elevated total water levels above the predicted tide.

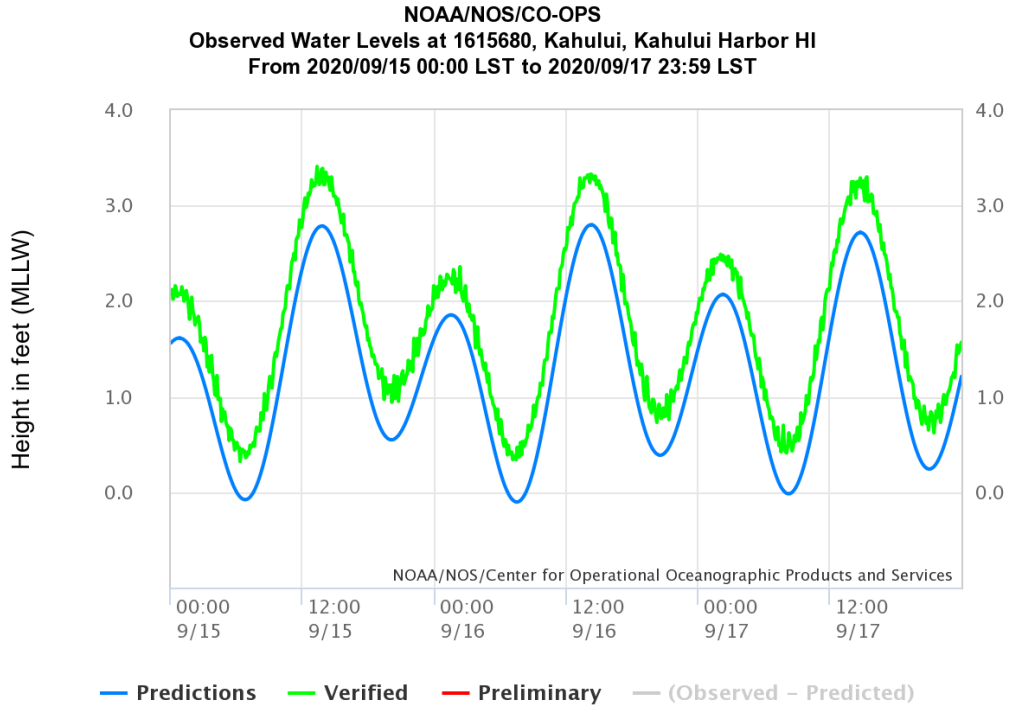


Figure 6-6. Observed water levels during the sand placement (Maintenance #3)

Waves: Waves at the offshore buoy, located at Pauwela, Maui, recorded wave heights of 3-4 feet from the northeast with a mean period of 5 seconds (Figure 5-8). During sand placement, observations of waves at the shoreline were less than one foot.

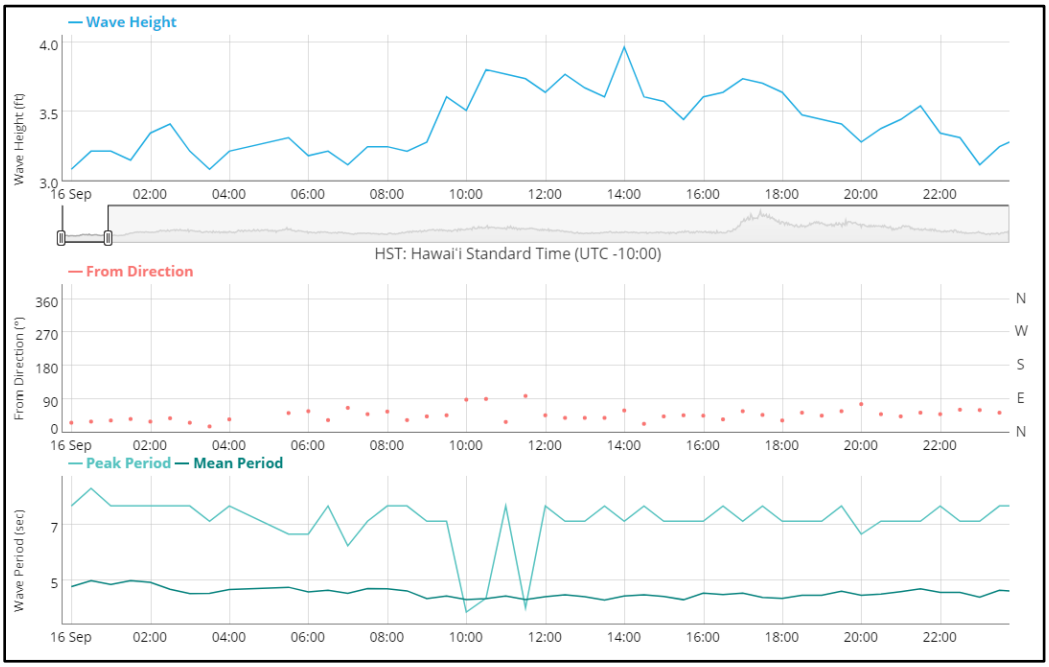


Figure 6-7. Pauwela wave buoy data for September 16, 2020 (Maintenance #3)

Winds: Winds at the project site were high for the duration of the project, with speeds of 15 – 20 mph (13 knots) and gusts above 25 mph (21 knots). The general wind direction was out of the east - northeast.

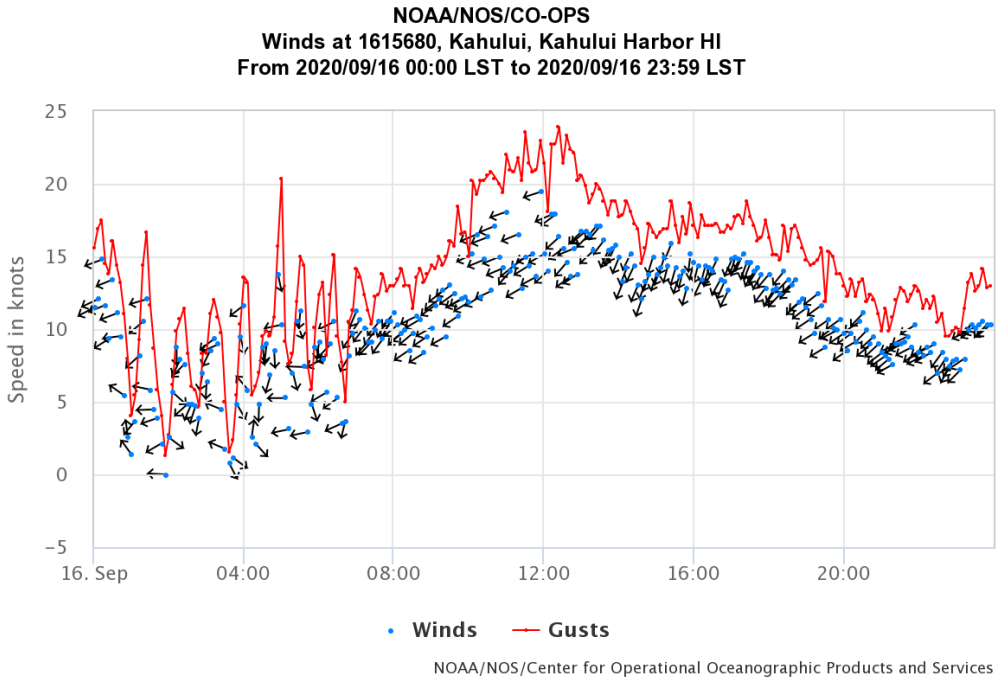
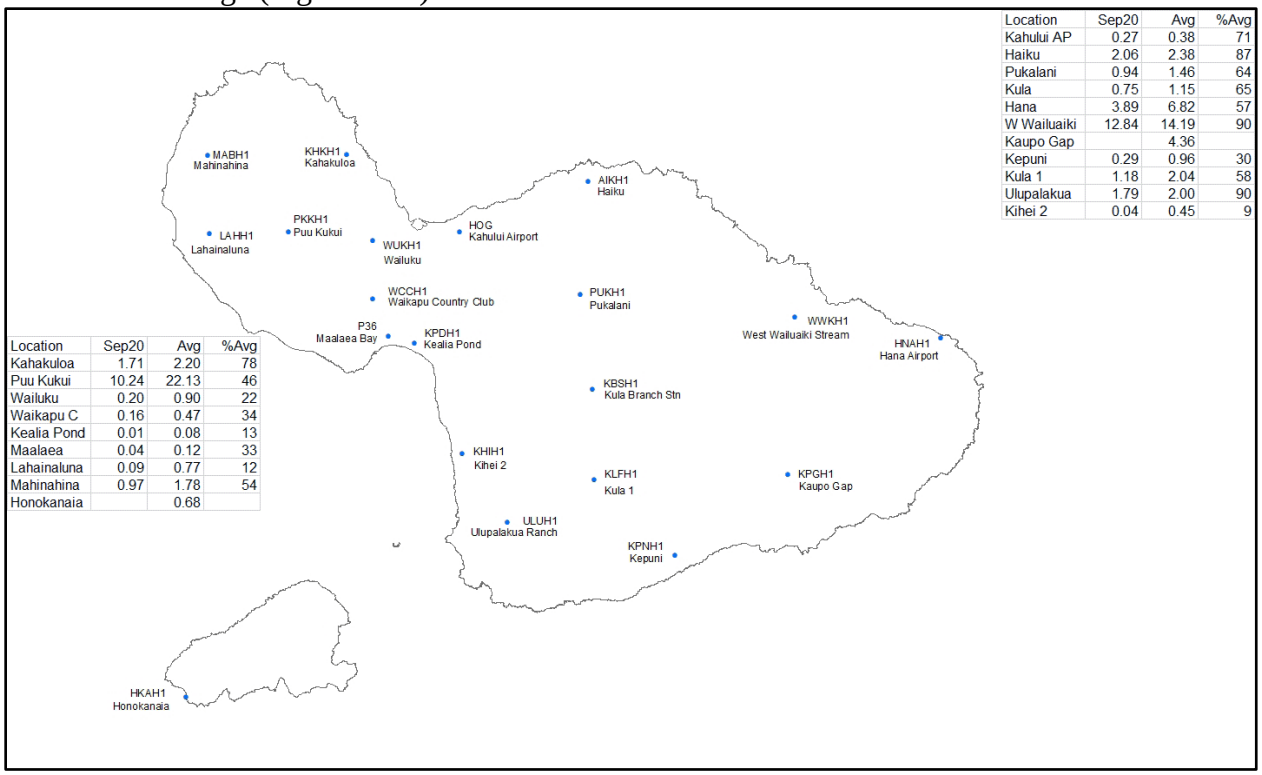


Figure 6-8. NOAA wind data for Kahului Harbor September 16, 2016 (Maintenance #3)

Precipitation: The month of September had below average rainfall (0.27 inches), which was 71% of the average (Figure 4-14).



Location	Sep20	Avg	%Avg
Kahakuloa	1.71	2.20	78
Puu Kukui	10.24	22.13	46
Wailuku	0.20	0.90	22
Waikapu C	0.16	0.47	34
Kealia Pond	0.01	0.08	13
Maalaea	0.04	0.12	33
Lahainaluna	0.09	0.77	12
Mahinahina	0.97	1.78	54
Honokanaia		0.68	

Location	Sep20	Avg	%Avg
Kahului AP	0.27	0.38	71
Haiku	2.06	2.38	87
Pukalani	0.94	1.46	64
Kula	0.75	1.15	65
Hana	3.89	6.82	57
W Wailuaiki	12.84	14.19	90
Kaupo Gap		4.36	
Kepuni	0.29	0.96	30
Kula 1	1.18	2.04	58
Ulupalakua	1.79	2.00	90
Kihei 2	0.04	0.45	9

Figure 6-9. Regional precipitation from rain gauges on Maui for September 2020 (Maintenance #3)

Marine Species: No endangered or protected marine species were observed during the implementation of the project.

6.4 Maintenance Best Management Practices

All applicable practices within the approved Best Management Practices Plan were adhered to. In particular, these specific practices were important for protecting the environment and the public:

- A silt fence was placed at the base of the slope as the sand was pushed from west to east on the berm.
- All work was conducted above mean higher high water and above the swash zone.
- No equipment was operated in the swash zone.
- Project notification sign was posted at the County of Maui beach access and on the beach.
- The beach and nearshore waters were inspected prior to initiation of work and throughout the project to ensure that no protected marine species were within 50 yards of the project area.

7. BERM MAINTENANCE EFFORT #4 – FALL 2021

This berm maintenance effort was conducted on September 28, 2021.

7.1 Maintenance Plan Parameters

Trigger: The berm elevation at Transect 5 was deflated to below the trigger elevation of +10 feet.

Sand Source: Pacific Aggregate LLC "Natural Sand Blended" was used for the maintenance effort, as was approved with SSBN MA-15-02. The slightly coarser sand is expected to have a longer residence time on the beach than that for previous nourishment efforts, particularly since the smaller grain size range (< D_{50}) is coarser.

Volume: The recommended volume for each maintenance event is 800-1,000 cubic yards of placed sand. Maintenance operations resulted in the placement of 1,500 tons of sand on the beach. Using a conversion factor of 1.35 tons per cubic yard results in 1,111 cubic yards of sand placed.

7.2 Maintenance Sand Placement

Delivery Method: The sand was first shipped from Oahu to Maui on a barge. Several delays with the barge and weather resulted in a 5-day delay of arrival to Maui. The Pacific Aggregate sand was located on the barge for the duration of the delay. The sand arrived on September 28, 2021. From Kahului Harbor, Gnomes Trucking and Tavares Trucking utilized vehicles to maintain a consistent delivery pace of about 12 trucks per hour for a total of about 60 truckloads between 1000 and 1700. Truck delivery of sand to the berm was at the west end of the embayment, through the Sugar Cove property to the public beach. A small gap was cut into the sand bank (Figure 7-1) allowing the trucks to deliver sand directly to the berm.

Placement: Two operators, contracted by Tavares Trucking, used two Komatsu 39EX bulldozers (Figure 7-2) to move sand along the berm and shape the new sand bank. Sand pushing and grading were completed from west to east along the berm. All sand moving and grading was conducted on the berm, makai of the shoreline vegetation and well inland from mean higher high water. The maintenance sand berm abutted the boulders and sand bank on the mauka side and extended from the west end of the property to the wall at the east end of the beach (Figure 7-3). No sand was added to the access path because it was still full. Too much sand on the path would make it too steep of a slope.

Final Grade: The upper portion of the berm maintenance sand was placed atop the low elevation berm (Figure 7-3) on the beach profile and was graded to a nearly horizontal plane (Figure 7-4). The makai face of the material was graded to as gentle a slope as was possible, given the already deflated and narrow beach profile.

Figure 7-1. Dump truck delivering sand to the west end of the cove for placement on the berm (Maintenance #4)

Figure 7-2. Bulldozer spreading sand along the berm (Maintenance #4)

Figure 7-3. Graded sand with finished makai slope ending near the public access at the eastern neighbor's seawall (Maintenance #4)

Figure 7-4. Beach and berm condition after placement on September 29, 2021 (Maintenance #4)

Figure 7-5. County of Maui beach access path during sand placement (Maintenance #4)

7.3 Maintenance #4 Environmental Conditions

Environmental observations were collected routinely before, during, and after project operations.

Tides: Tides were highest in the morning with lower low tides in the evening (Figure 6-6). Morning highs were 1.9 feet MLLW and the low was 0.42 feet MLLW, resulting in an outgoing

tide for most of the day. The maintenance activity schedule ensured that placement and grading operations were generally during lower tides.

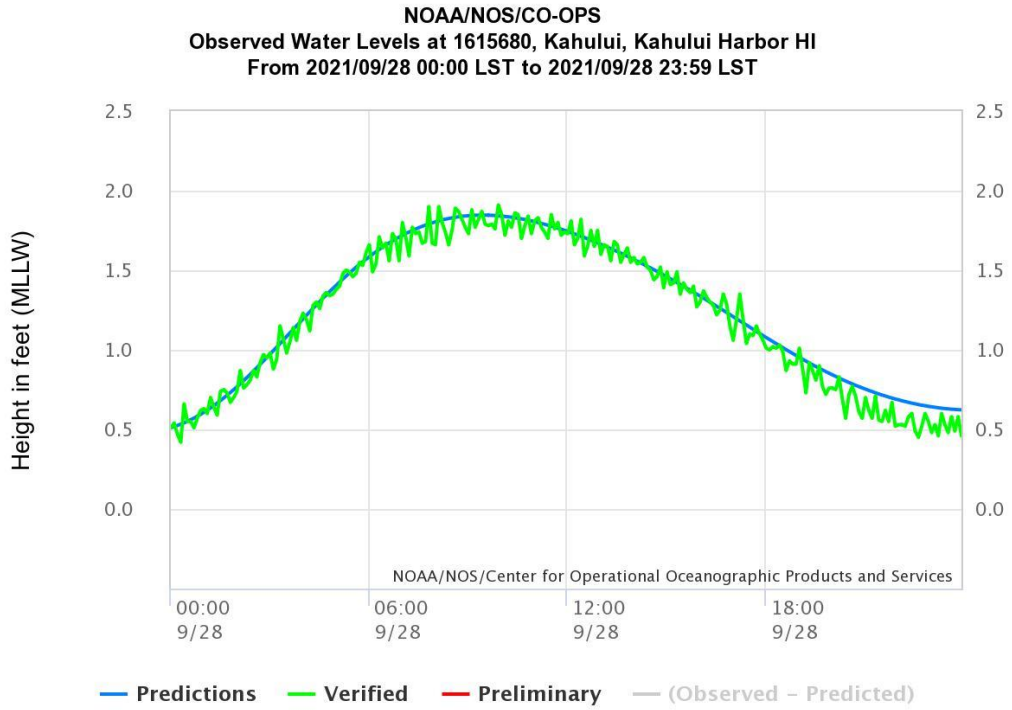


Figure 7-6. Observed water levels during the sand placement (Maintenance #4)

Waves: Wave data from the Pauwela buoy was not available for the Maintenance #4 time frame. The Northern Hawaii One (Station ID 51000) buoy maintained by NOAA, located about 235 miles off the north coast of Maui, recorded wave heights of 6-7 feet from the northeast with an average peak period of 8 seconds (Figure 7-7). During sand placement, observations of waves at the shoreline were less than one foot.

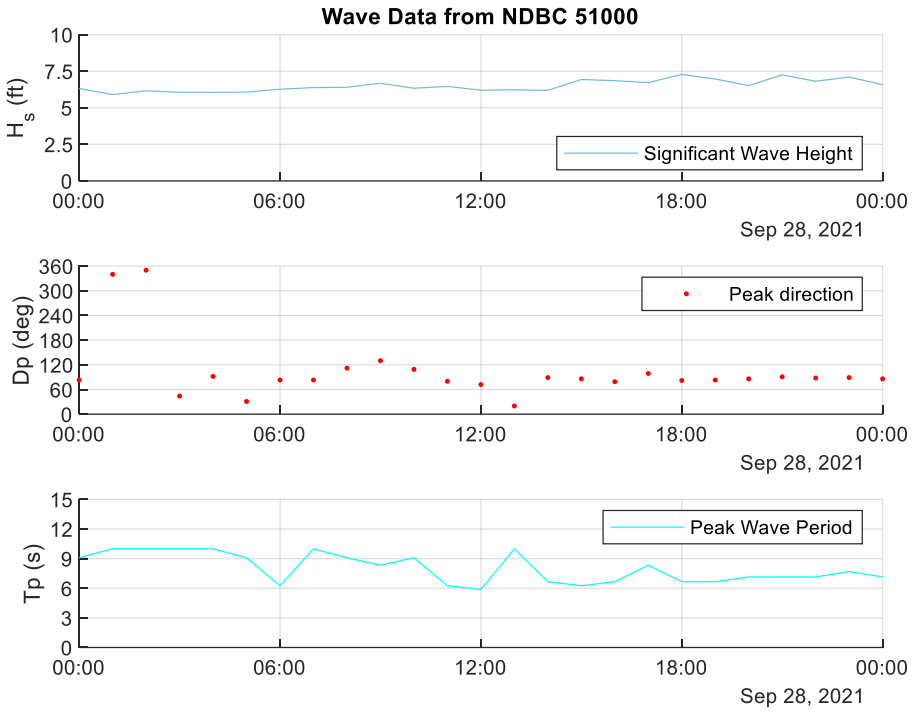


Figure 7-7. Northern Hawaii One (Station 51000) wave buoy data for September 28, 2021 (Maintenance #4)

Winds: Winds at the project site varied for the duration of the project, with speeds of 5 – 22 mph (4 – 15 knots) and gusts above 28 mph (25 knots). The general wind direction was out of the east - northeast.

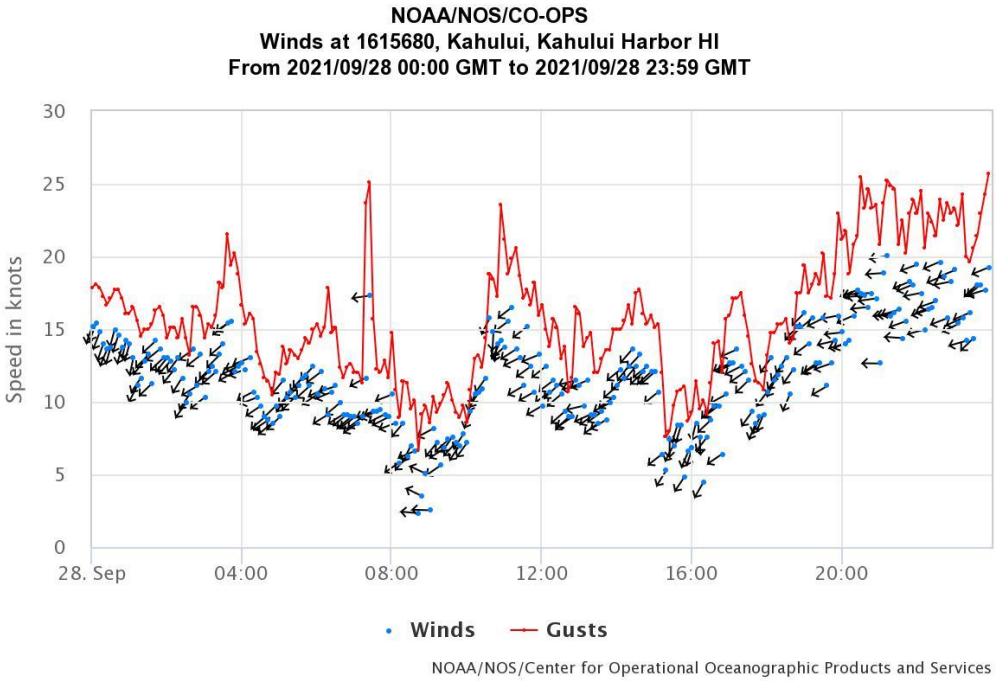


Figure 7-8. NOAA wind data for Kahului Harbor September 28, 2021 (Maintenance #4)

Precipitation: The month of September saw generally below average rainfall throughout the region. Data from the station nearest to the maintenance site was not available for September 2021, however the National Weather Service station at Haiku to the east of the site registered below average rainfall.

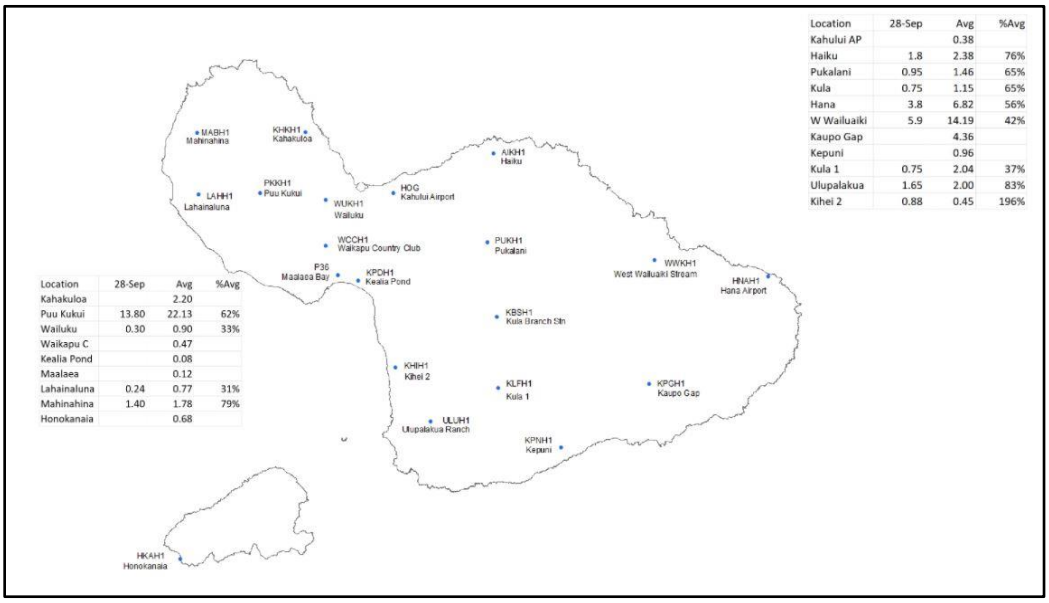


Figure 7-9. Regional precipitation from rain gauges on Maui for September 2021 (Maintenance #4)

Marine Species: Several green sea turtles were observed in the area during construction; however, none were within 50 yards of the maintenance activities. No other endangered or protected marine species were observed during the implementation of the project.

7.4 Maintenance Best Management Practices

All applicable practices within the approved Best Management Practices Plan were adhered to. In particular, these specific practices were important for protecting the environment and the public:

- A silt fence was placed at the base of the slope as the sand was pushed from west to east on the berm.
- All work was conducted above mean higher high water and above the swash zone.
- No equipment was operated in the swash zone.
- Project notification sign was posted at the County of Maui beach access and on the beach.
- The beach and nearshore waters were inspected prior to initiation of work and throughout the project to ensure that no protected marine species were within 50 yards of the project area.

8. ADAPTIVE MANAGEMENT PLAN DATA

8.1 Quality of Placed Material – Maintenance Effort #1

8.1.1 Pre-Maintenance Beach Sand

The existing beach is a product of nearly two decades of maintenance activities conducted by the Association, during which time they have placed almost 30,000 cy of beach quality sand on the coastline. The ongoing efforts have reestablished and stabilized a sandy beach profile seaward and atop the existing erosion mitigation structure. Existing beach sand is a combination of native and fill material that have intermixed along the coastline.

Figure 8-1 is a graph of the sand samples collected prior to the first maintenance effort. These samples were collected within the swash zone, at the wet/dry line, on the upper beach face, and from the berm near the stairwell at the center of the project area's shoreline. The composite sample is a combination of all four of these samples. Also shown on the graph are the +/- 20% thresholds for the composite beach sand sample. The composite sample of beach sand grains is normally sorted material within the range of coarse (1 mm) to very fine (0.125 mm) sand. The composite sample's median grain size is within the medium sand range, just smaller than 0.4 mm in diameter.

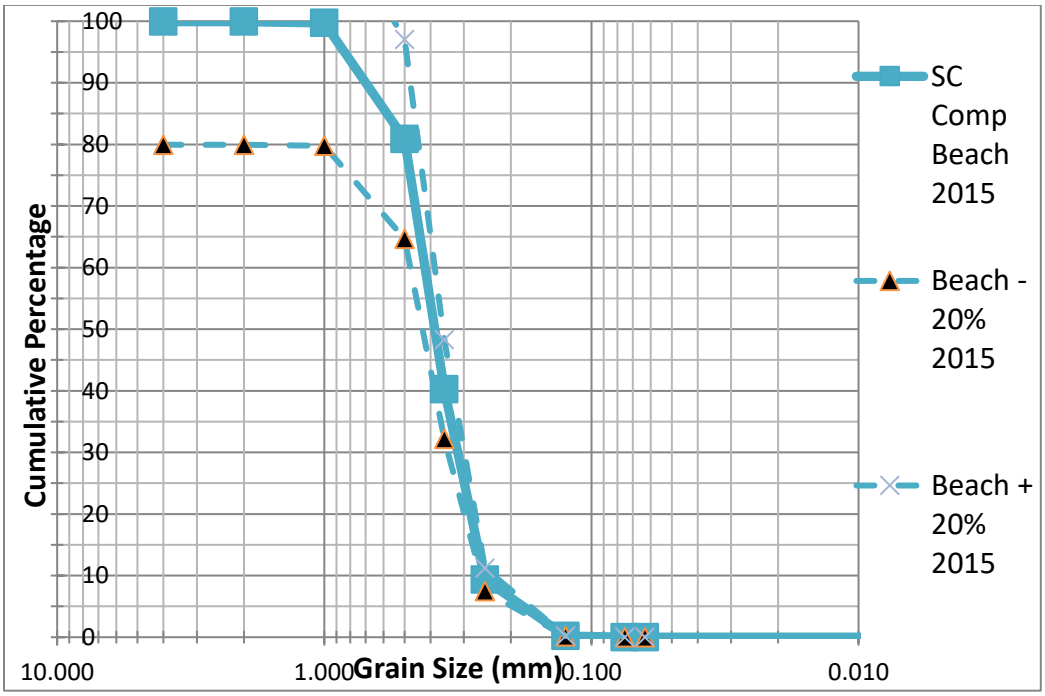


Figure 8-1. Grain size distribution for beach sand samples, composite beach sample, and the +/- 20% thresholds (Pre-Maintenance #1)

Figure 8-2 depicts the grain size fraction relationship between Sugar Cove's restored beach and Kanaha Beach, which is a native beach that is also located within Spartan Reef. The composite sample from Kanaha Beach fits within the +/-20% ranges of Sugar Cove's composite beach sand and is overlapping for median grain size. The similarity between the two samples further highlights the success of previous restoration efforts at Sugar Cove.

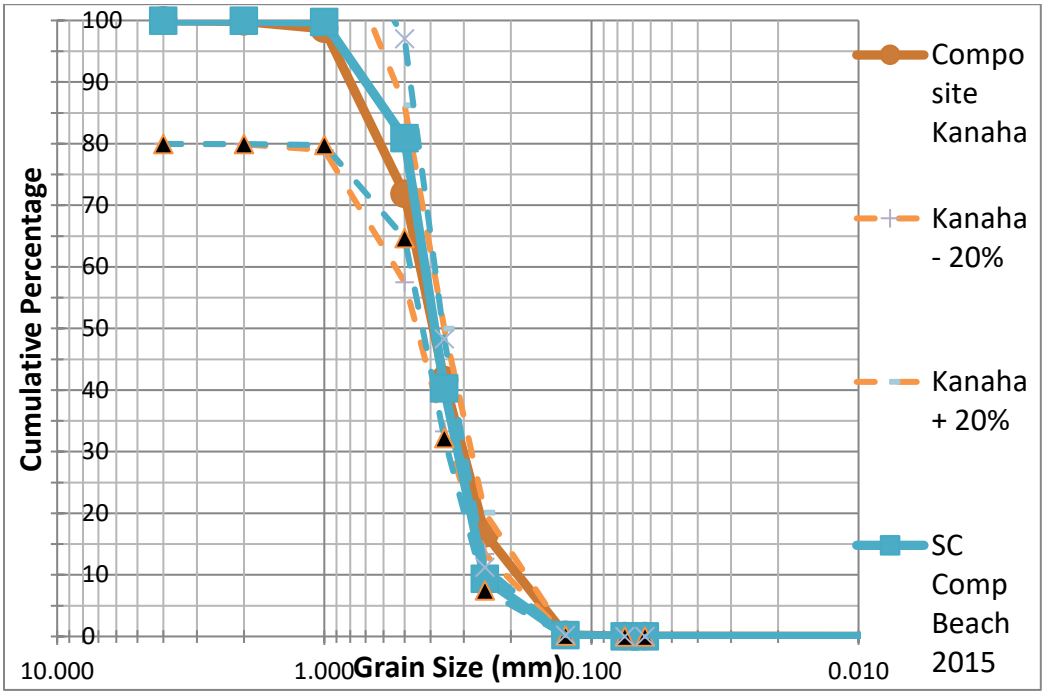


Figure 8-2. Grain size distribution for beach sand samples for Sugar Cove and Kanaha Beach, composite beach sample, and the +/- 20% thresholds (Pre-Maintenance #1)

8.1.2 Berm Maintenance Sand – Maintenance Effort #1

Ameron Inland Dune Sand has been a consistent source of beach quality fill material on the island of Maui and was utilized in all the previous beach restoration efforts by the Association. This material has already been excavated, sorted, and stockpiled by Ameron (now known as HC&D).

This sand is light reddish brown in color and has a median grain size of 0.28 mm. 97.9% of the material is within the range of sand grain size, and 2.1% is silt size. This material is dominantly marine carbonate sediment in origin. The berm fill sand did not fit entirely within the +/- 20% brackets around the composite existing beach sand sample (Figure 8-3). This may be a result of variation in the sieve sizes used for analysis of the sand samples. Regardless, the berm fill sample was finer in nature than the existing beach sand.

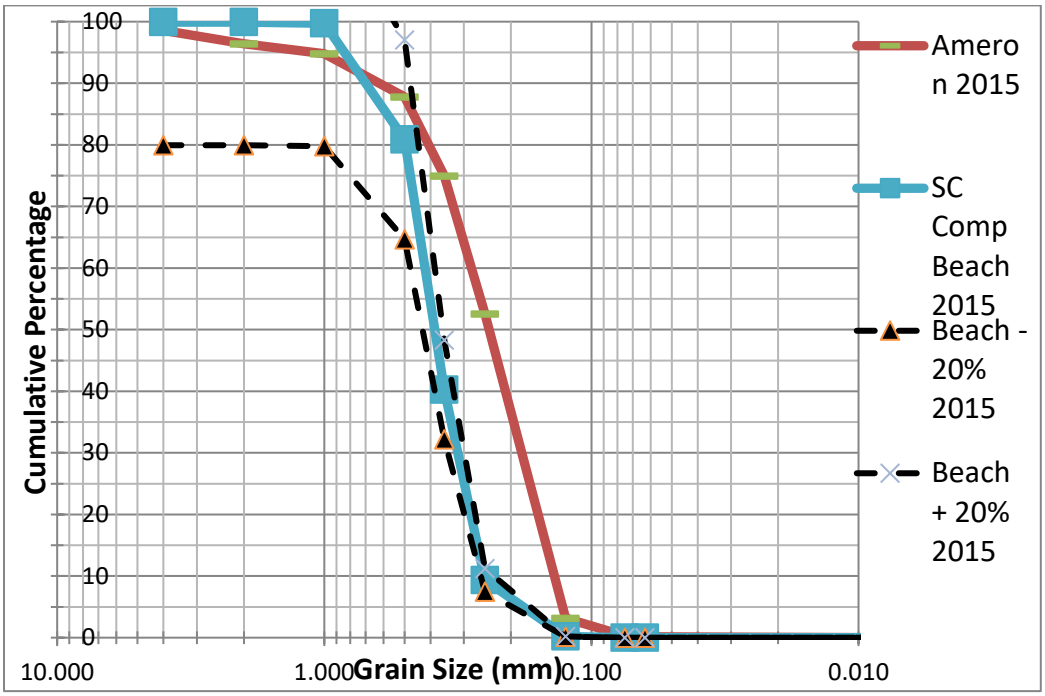


Figure 8-3. Grain size distribution for composite beach sample, the +/- 20% thresholds and the berm fill sand sample (Maintenance #1)

8.2 Quality of Placed Material – Maintenance Effort #2

8.2.1 Pre-Maintenance Beach Sand

The pre-maintenance beach sand is a combination of native and fill material that have intermixed along the coastline. These 2016 samples were collected six months after the first maintenance effort and three months before the second maintenance effort.

Figure 8-4 is a graph of the grain size distribution from the sand samples after maintenance #1 and before maintenance #2 (SC Comp Beach 2016). These samples were collected within the swash zone, at the wet/dry line, on the upper beach face, and from the berm near the stairwell at the center of the project area's shoreline. The composite sample is a combination of all four of these samples. Also shown on the graph are the +/- 20% thresholds for the composite beach sand sample.

The composite sample of beach sand grains is normally sorted material within the range of coarse (1 mm) to very fine (0.125 mm) sand. The composite sample's median grain size is within the medium sand range, just smaller than 0.4 mm in diameter.

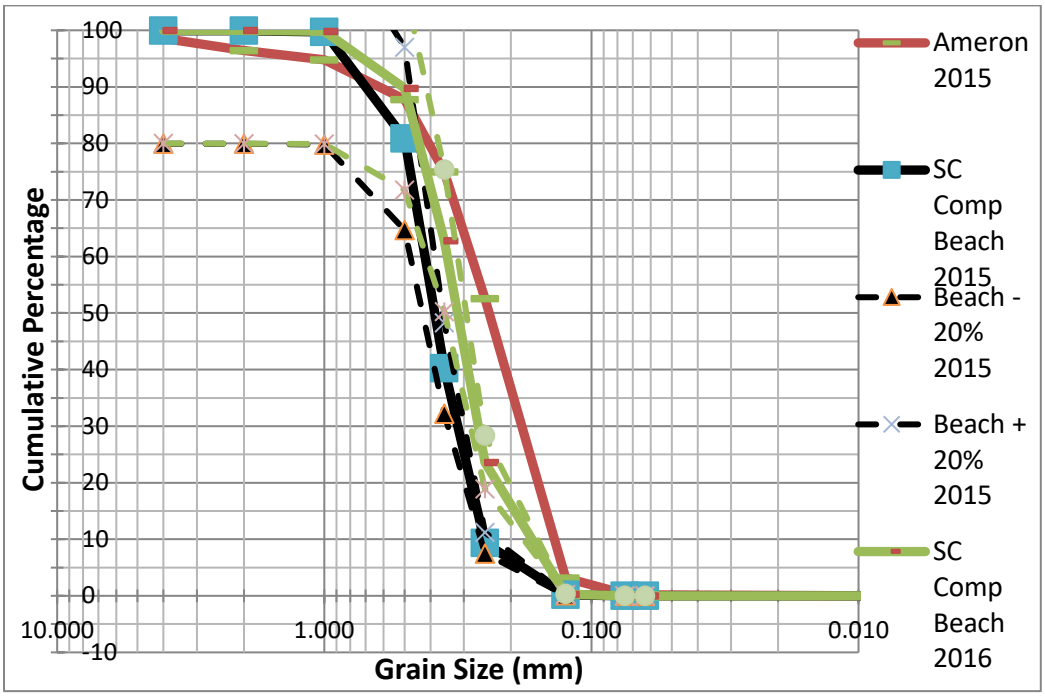


Figure 8-4. Grain size distribution for pre-maintenance and post-maintenance composite Sugar Cove beach samples, and the +/- 20% thresholds (Pre and post-maintenance #1)

8.2.2 Berm Maintenance Sand – Maintenance Effort #2

Ameron Inland Dune Sand was utilized again for maintenance effort #2 in 2016. The berm fill sand did not fit entirely within the +/- 20% brackets around the composite existing beach sand sample (Figure 8-5). This may be a result of variation in the sieve sizes used for analysis of the sand samples. Regardless, the berm fill sample was finer in nature than the existing beach sand.

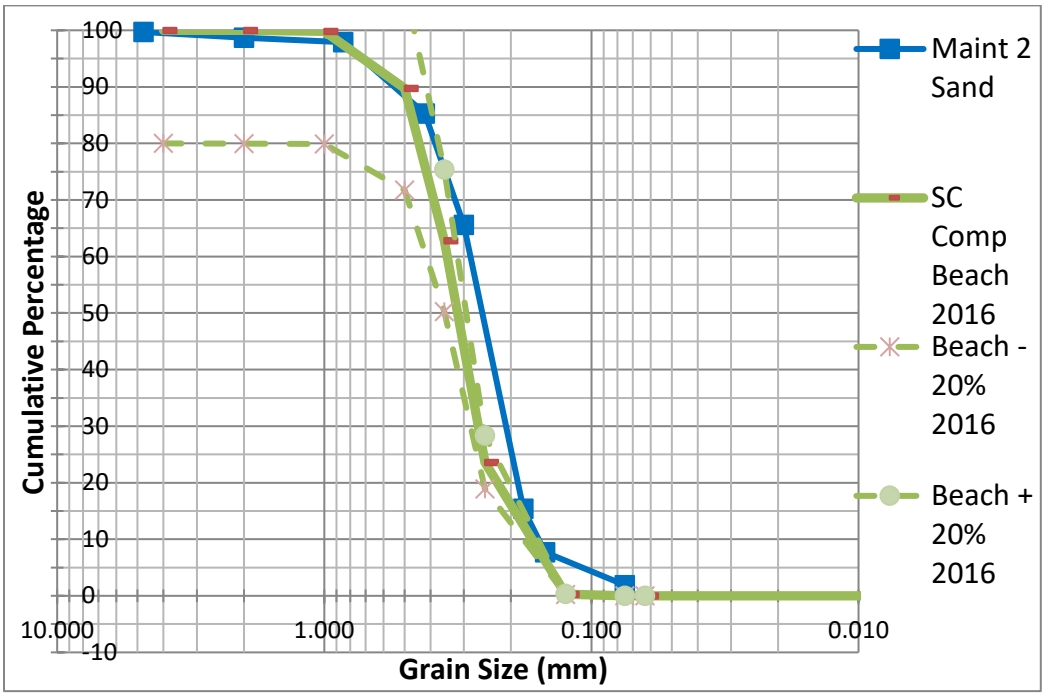


Figure 8-5. Grain size distribution for composite beach sample, the +/- 20% thresholds and the berm fill sand sample (Maintenance #2)

8.2.3 Post-Maintenance Beach Sand

The post-maintenance #2 beach sand is a combination of native and fill material that have intermixed along the coastline. These samples were collected 8 months after the second maintenance effort and before the third maintenance effort. The third maintenance effort was never conducted due to local issues with the sand source. Figure 8-6 shows a comparison of the 2016 pre-maintenance #2 sugar cove sand and the post-maintenance #2 2017 beach sand.

Figure 8-7 is the post-maintenance #2 sand distribution and the Ameron (HC&D) sand source that would have been used for maintenance #3. The composite sample of beach sand grains is normally sorted material within the range of coarse (1 mm) to very fine (0.125 mm) sand. The composite sample's median grain size is within the medium sand range, just smaller than 0.4 mm in diameter.

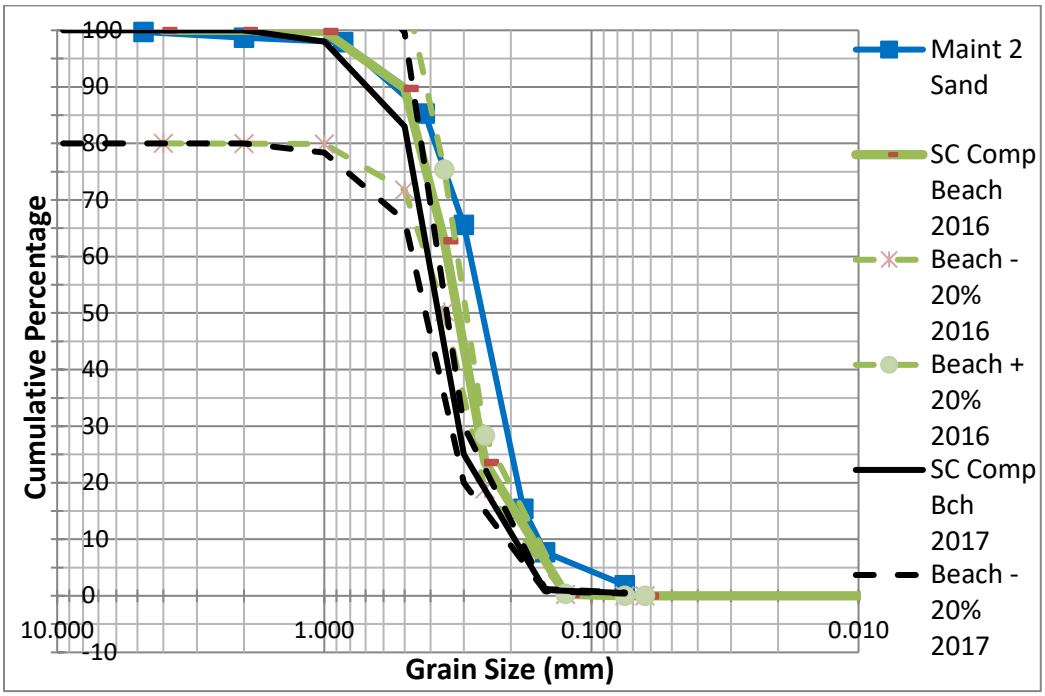


Figure 8-6. Grain size distribution for beach sand samples, composite beach sample (Post-Maintenance #2)

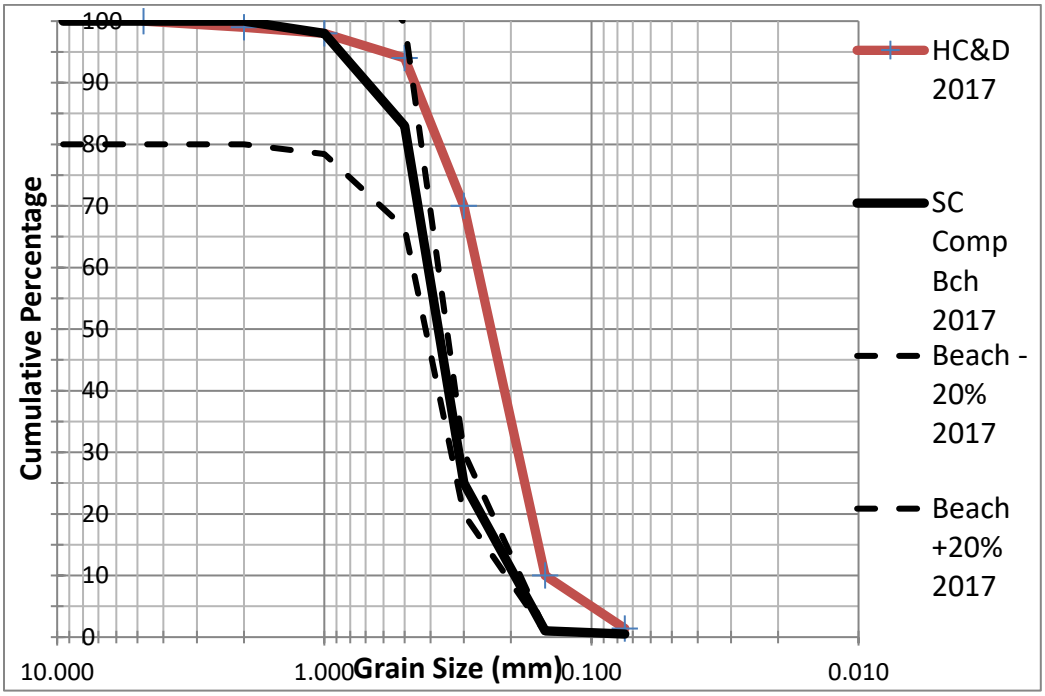


Figure 8-7. Grain size distribution for composite Sugar Cove beach samples, and the +/- 20% thresholds for the pre-maintenance sample (Post-maintenance #2, Pre-maintenance #3 that did not occur)

8.3 Quality of Placed Material – Maintenance Effort #3

8.3.1 Pre-Maintenance Beach Sand

The pre-maintenance beach sand is a combination of native and fill material that have intermixed along the coastline. These 2019 samples were collected two years after the second maintenance effort and 18 months before the third maintenance effort.

Figure 8-4 is a graph of the grain size distribution from the sand samples after maintenance #2 and before maintenance #3. These samples were collected within the swash zone, at the wet/dry line, on the upper beach face, and from the berm near the stairwell at the center of the project area's shoreline. The composite sample is a combination of all four of these samples. Also shown on the graph are the +/- 20% thresholds for the composite beach sand sample.

The 2019 composite sample of beach sand grains is normally sorted material within the range of coarse (1 mm) to very fine (0.125 mm) sand. The composite sample's median grain size is within the medium sand range, just smaller than 0.4 mm in diameter.

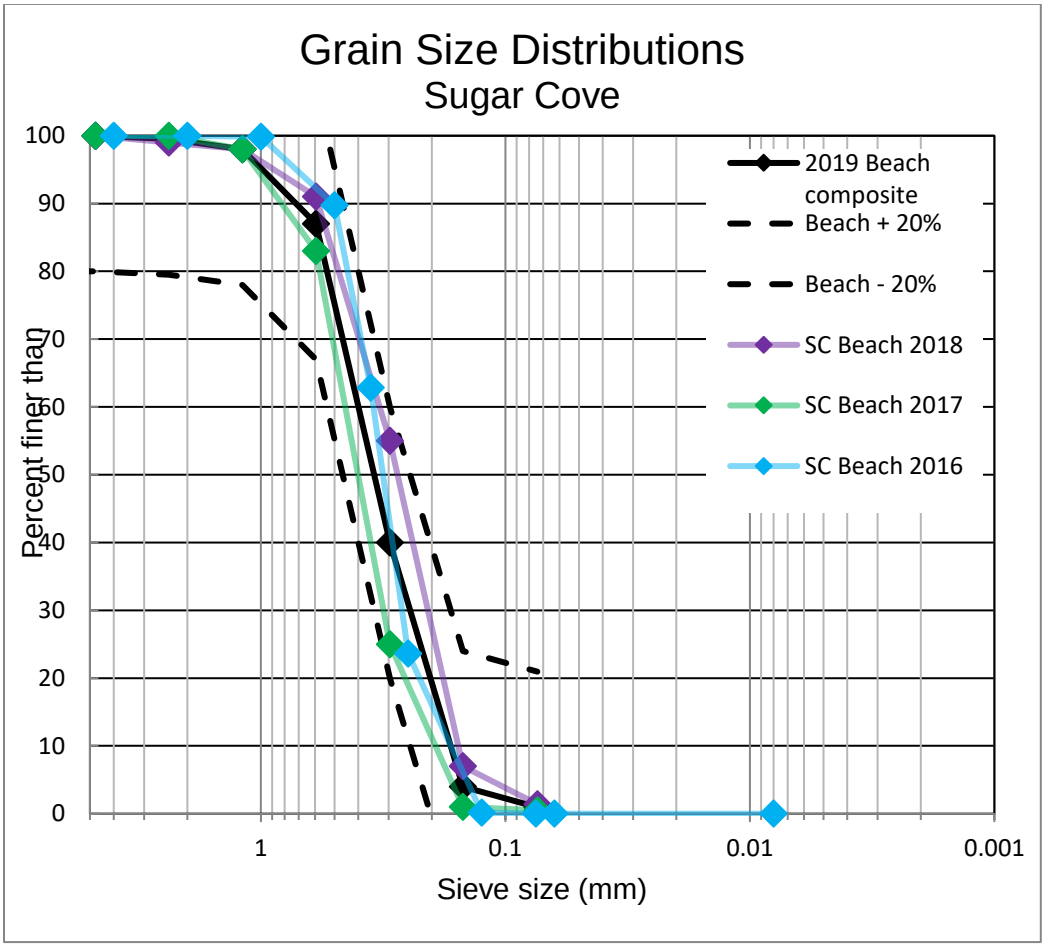


Figure 8-8. Grain size distribution for Sugar Cove beach samples, and the +/- 20% thresholds

8.3.2 Berm Maintenance Sand – Maintenance Effort #3

Pacific Aggregate LLC "Natural Sand Blended" was utilized for maintenance effort #3 in 2020. The berm fill sand did not fit entirely within the +/- 20% brackets around the composite existing beach sand sample (Figure 8-5). The berm fill sample was coarser in nature than the existing beach sand.

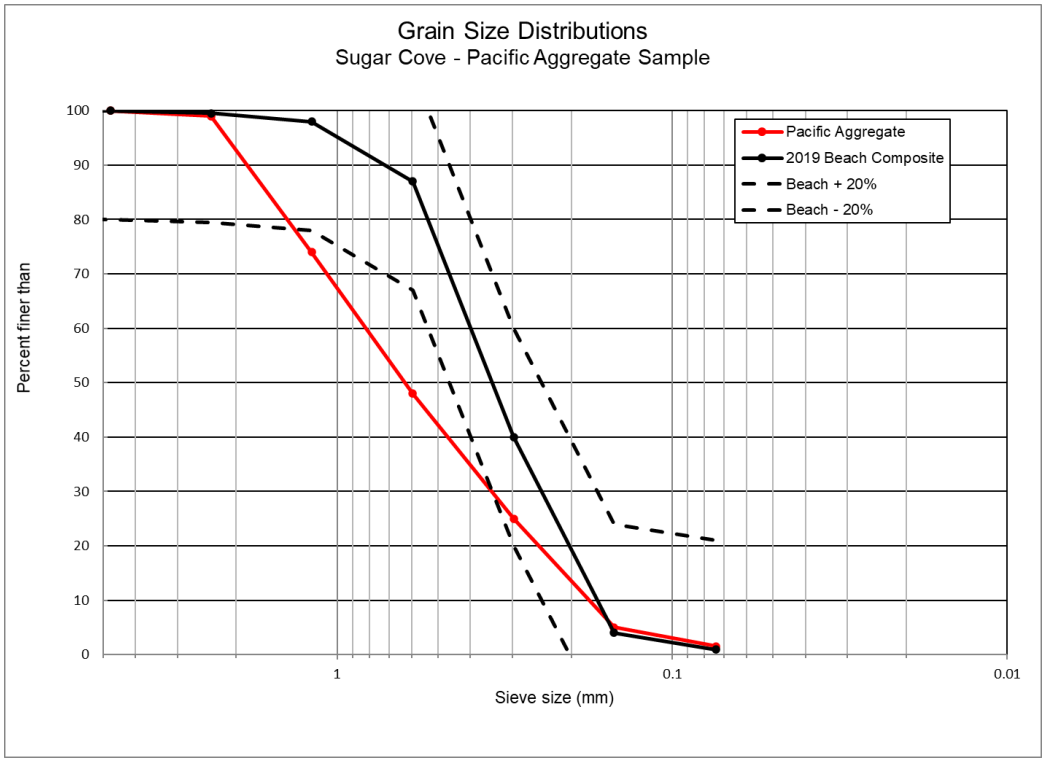


Figure 8-9. Grain size distribution for composite beach sample, the +/- 20% thresholds and the berm fill sand sample (Maintenance #3).

8.4 Quality of Placed Material – Maintenance Effort #4

8.4.1 Pre-Maintenance Beach Sand

The pre-maintenance beach sand is a combination of native and fill material that have intermixed along the coastline. These 2021 samples were collected on September 28, 2021. Examples of the beach composite sand and the aggregate for maintenance #4 are shown in Figure 8-10.

Figure 8-10. Samples of sand from the native beach at Sugar Cove compared to the aggregate used for berm maintenance #4

Figure 8-11 is a graph of the grain size distribution from the sand samples after maintenance #3 and before maintenance #4. These samples were collected within the swash zone, at the wet/dry line, on the upper beach face, and from the berm near the stairwell at the center of the project area's shoreline. The composite sample is a combination of all four of these samples. Also shown on the graph are the +/- 20% thresholds for the composite beach sand sample.

The 2021 composite sample of native beach sand grains is normally sorted material within the range of coarse (1 mm) to very fine (0.125 mm) sand. The composite sample's median grain size is within the medium sand range, just smaller than 0.4 mm in diameter.

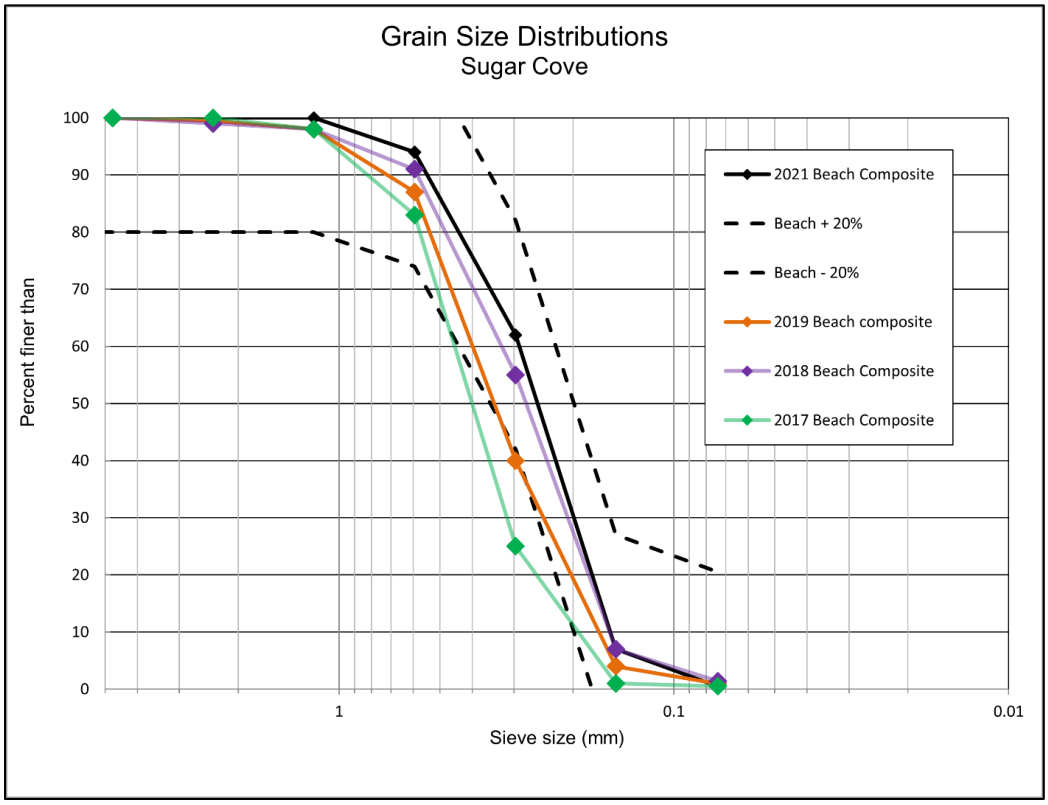


Figure 8-11. Grain size distribution for Sugar Cove beach samples, and the +/- 20% thresholds

8.4.2 Berm Maintenance Sand – Maintenance Effort #4

Pacific Aggregate LLC "Natural Sand Blended" was utilized for maintenance effort #4 in 2021. The berm fill sand did not fit entirely within the +/- 20% brackets around the composite existing beach sand sample (Figure 8-12). The berm fill sample was coarser in nature than the existing beach sand. Sand samples prior to the maintenance effort, from the stockpile on Oahu, were similar to the 2020 samples. Grain size analysis results presented below are from hand samples collected during the maintenance effort.

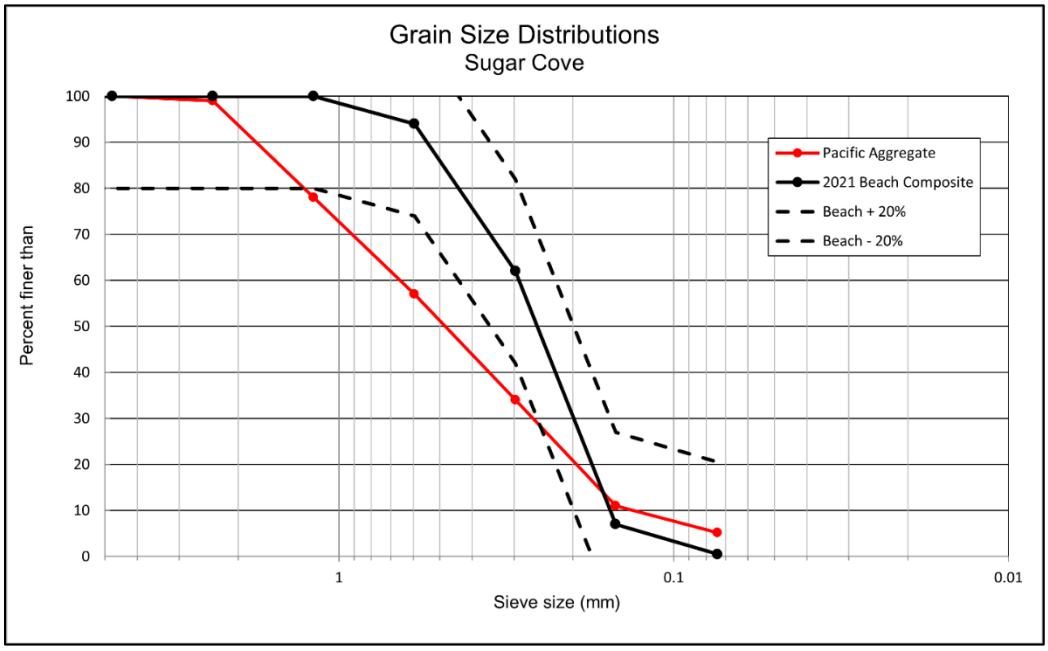


Figure 8-12. Grain size distribution for composite beach sample, the +/- 20% thresholds and the berm fill sand sample (Maintenance #4)

8.5 Small Scale Beach Nourishment Standards and Sediment Compatibility

Berm fill is evaluated for compatibility using the standards outlined in the *Guidelines for SSBN Cat II General Application*.

The berm fill sand does not exceed 6% fine sediment. Berm fill sand is approximately 5.2% fine sediment, which is below the allowable limit for fine material as identified in the standards.

Analysis shows the berm fill sand has between 5.2% and 11.0%, by volume, sediment 0.125 mm or smaller. This is less than one-fifth of the 50%, by volume, threshold identified in the standards.

The berm fill sand has no volume in the size fraction larger than 4.76 mm. The largest grain size in the beach fill sand is 1.0%, by volume, between 2.00 to 4.00 mm and does not exceed the 10%, by volume, limit for grains larger than 4.76 mm.

Due to the finer sediment sizes of the berm fill sand, when compared to the composite beach sand samples, overfill analysis was conducted for the first two maintenance efforts. This fulfills the requirement in the State's nourishment guidelines. Calculation of the overfill factor (Table 8-2 and Table 8-3) indicates that maintenance efforts needed to use 126% and 117% more sand than the desired volume, due to losses associated with preferential winnowing of fines through normal littoral cell processes for maintenance #1 and #2 respectively. Maintenance #3 and #4 had less fine material than the native beach and is expected to have a longer lifespan on the beach with any fines being washed out under wave action. Coarser fill material produces overfill ratios of 1.00.

Table 8-1 and
Figure 8-13 show the grain size distributions for the recent composite beach sample and the beach quality fill materials.

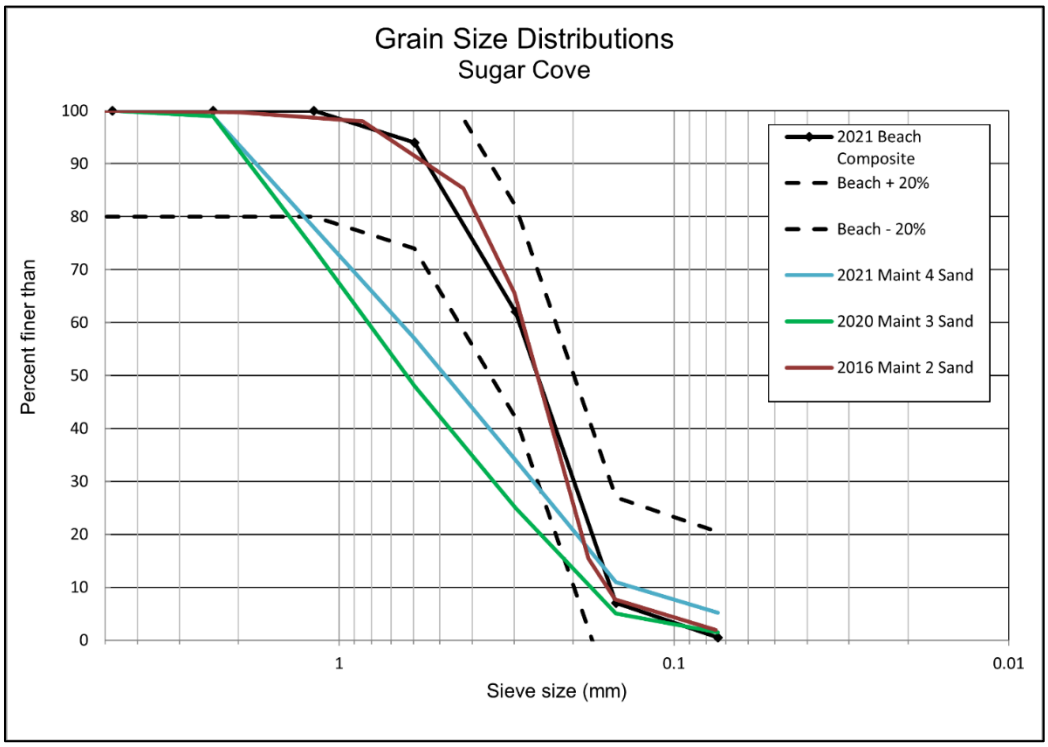


Figure 8-13. Grain size distributions for Sugar Cove beach quality fill sand

Table 8-1 Grain size distributions for Sugar Cove existing beach and beach quality fill sand

Sieve Size	**<5**	**8**	**10**	**16**	**18**	**30**	**35**	**45**	**50**	**60**	**100**	**120**	**200**	**230**
Mesh Size (mm)	**>=4.00**	**2.380**	**2.000**	**1.190**	**1.000**	**0.595**	**0.500**	**0.355**	**0.297**	**0.250**	**0.149**	**0.125**	**0.075**	**0.063**
Sugar Cove Beach (2015)	99.925		99.925		99.725		80.850	40.250		9.325		0.175	0.000	0.000
Sugar Cove Beach (2016)	100.00		99.985		99.845		89.728	62.833		23.628		0.308	0.017	0.000
Sugar Cove Beach (2017)	100.000		100.00		98.000		83.000	25.000			1.000		0.500	
Sugar Cove Beach (2019)	100.00		100.00			97.00			66.00		8.0		1	
Sugar Cove Beach (2021)	100	100		100		94.00			62.00		7.00		0.50	
Sugar Cove Beach (2023)	100	100		99.00		83.00			37.00		2.00		0.10	
Ameron Pre-2014	100.00		97.700								4.8		2.100	
Ameron 2014			100.00		99.000		97.000			71.000		9.600		0.900
Ameron 2015	98.571		96.417		94.789		87.787	74.977		52.553		3.185	0.316	0.152
Ameron 2016	99.720		98.470		97.390		91.670	80.130		55.680		3.550	1.160	1.020
Ameron 2017	100.00		99.000		98.000		94.000	70.000			10.000		1.400	
Pacific Aggregate 2020	100.00		99.00		98.00	87.00			70.00		10.00	3.50	0.047	
Pacific Aggregate 2021	100	99.00		78.0		57.00			34.00		11.00		5.20	
Pacific Aggregate 2023	100	99.00		76.0		53.00			30.00		8.0		2.9	

Table 8-2 Overfill calculations for the berm fill sand (Maintenance #1)

Parameter	Value
Mn	1.34
Mb	1.70
Sigma	0.98
Mb' – Mn'	0.36
Overfill Factor K	1.26

Table 8-3 Overfill calculations for the berm fill sand (Maintenance #2)

Parameter	Value
Mn	1.70
Mb	1.90
Sigma	0.77
Mb' – Mn'	0.266
Overfill Factor K	1.17

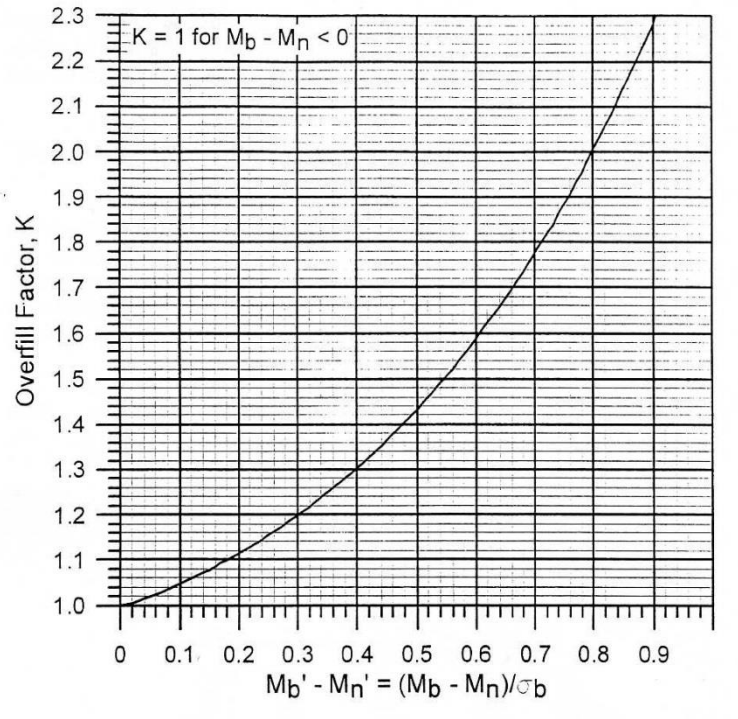


Figure 8-14. Overfill Factor conversion chart

8.6 Coastal and Marine Environmental Conditions

8.6.1 Nearshore Water Quality Observations

8.6.1.1 Maintenance Effort # 1

Visual observations for water quality were collected periodically before, during, and after completion of the berm maintenance effort. Water quality in the nearshore, or between the shoreline and the reef crest offshore, varied significantly along the shoreline, however, offshore conditions beyond the reef crest appeared to be ubiquitous (Figure 8-15-Figure 8-17, Table 8-4). Offshore water quality was noticeably clearer directly offshore of the reef crest. Observations of the nearshore waters at Sugar Cove, Baldwin Beach, and Laulea (the western cove abutting Sugar Cove) are also presented in Table 8-4.

Figure 8-15. Water quality conditions at Sugar Cove, 10:15 on November 09, 2015

Figure 8-16. Water quality conditions at Sugar Cove, 09:12 on November 10, 2015

Figure 8-17. Water quality conditions at Sugar Cove, 14:48 on November 10, 2015

Table 8-4 Water quality observations during maintenance #1 efforts.

Date - Time	Sugar Cove Nearshore	Baldwin Beach Nearshore	Laulea Nearshore
2015/11/09 - 0700	Turbid waters, varied from milky to light red shades	Very turbid water with milky coloring, extending alongshore toward Sugar Cove	Very turbid water with red plumes in milky waters, plumes not connected to Sugar Cove
2015/11/09 - 1130	Turbid waters, varied from milky to light red shades	Very turbid water with milky coloring, extending alongshore toward Sugar Cove	Turbidity decreasing with lesser red plumes in milky waters, plumes not connected to Sugar Cove
2015/11/09 – 1630	Same condition as mid-day		
2015/11/10 – 0700	Water quality improved at all three sites with decreased wave frequency and lighter winds overnight.		
2015/11/10 – 0915	Turbid waters, varied from milky to light red shades. Milky waters moving west from Baldwin Beach area.	Very turbid water with milky coloring, extending alongshore toward Sugar Cove	Turbid water with red plumes in milky white nearshore waters. The Plumes are not connected to Sugar Cove.
2015/11/10 – 1430	Same condition as mid-morning		

8.6.1.2 Maintenance Effort # 2

Visual observations for water quality were collected periodically before, during, and after completion of the berm maintenance effort. Water quality in the nearshore, or between the shoreline and the reef crest offshore, varied significantly along the shoreline, however, offshore conditions beyond the reef crest appeared to be ubiquitous (Figure 8-18-Figure 8-20, Table 8-5). Offshore water quality was noticeably clearer directly offshore of the reef crest. Observations of the nearshore waters at Sugar Cove, Baldwin Beach, and Laulea (the western cove abutting Sugar Cove) are presented in Table 8-5.

Figure 8-18. Water quality conditions at Sugar Cove, 11:15 on September 06, 2016

Figure 8-19. Water quality conditions at Sugar Cove, 17:50 on September 6, 2016. End of work day

Figure 8-20. Water quality conditions at Sugar Cove, 16:15 on September 7, 2016

Table 8-5 Water quality observations during maintenance #2 efforts.

Date - Time	Sugar Cove Nearshore	Baldwin Beach Nearshore	Laulea Nearshore
2016/09/06 -0700	Brown water advisory, poor water quality, tan/brown color		
		Heavy erosion	
2016/09/06 – 0900	Poor water visibility. Almost no visibility on the bottom. Worst on the east end.	Plume moving down the coast from Baldwin	Incoming turbidity from the east
2016/09/06 - 1030	Entire coast has been eroding and there is dirty water.		
2016/09/06 - 1750	Water quality improved throughout the day		
2016/09/07 - 1200	Entire shallow reef has white turbidity to reef crest.		
2016/09/07 - 1200	Brown turbid water intermittent along the coastline. There is poor visibility along the entire coastline.		
2016/09/07 - 1330	There is a thick white turbidity moving west from Baldwin.		
2016/09/07	Intermittent brown water spots along the entire coast		
2016/09/07	There is more white turbidity from wind and waves. There is less brown and red turbidity.		

8.6.1.3 March 2017 Site visit

Table 8-6 Water quality observations during March 2017 site visit

Date - Time	Sugar Cove Nearshore	Baldwin Beach Nearshore	Laulea Nearshore
2017/03/14 - 0800	Water quality highly variable within Sugar cove and along the coast regionally. There are mixtures of whiteish, tanish, and green/blue turbidity looking along the coast. There is no discernable pattern or trend.		
2017/03/14 – 0830-1000	There are turtles foraging near transect 1 and 3.		
2017/03/14 - 1015	There is lots of moving water around the cove.		
2017/03/14 - 1130			Very good water quality, quiet water.
2017/03/14 - 1200		Clean water flushing out of East end opening and mixing with white turbid water from Baldwin Beach area	

8.6.1.4 October 2017 Site visit

Table 8-7 Water quality observations during March 2017 site visit

Date - Time	Sugar Cove Nearshore	Baldwin Beach Nearshore	Laulea Nearshore
2017/10/05 - 0845	Almost no visibility, high regional turbidity	High regional turbidity	High regional turbidity
2017/10/05 - 1030	Turbidity is high, but patchy. No clear sources in the region, but color is variable along the coast ranging from milky to tan.		
2017/10/05 - 1220	Widespread turbidity throughout the region, patchy coloring. Visually worst at Baldwin and decreasing westward.		

8.6.1.5 January 2019 Site visit

Table 8-8 Water quality observations during January 2019 site visit

Date - Time	Sugar Cove Nearshore	Baldwin Beach Nearshore	Laulea Nearshore
2019/1/22 – 1300	Poor visibility, high regional turbidity		
2019/1/22 – 1306			Poor visibility, high regional turbidity
2019/1/22 – 1313		Poor visibility, high regional turbidity	

8.6.1.6 May 2019 Site visit

Table 8-9 Water quality observations during May 2019 site visit

Date - Time	Sugar Cove Nearshore	Baldwin Beach Nearshore	Laulea Nearshore
2019/5/22 – 1415	Clear skies, trade winds 17mph, 50-foot visibility, 1- to 1.5-foot waves		
2019/5/22 – 1435			Clear skies, trade winds 17mph, 10-foot visibility, 1- to 1.5-foot waves
2019/1/22 – 1457		Clear skies, trade winds 17mph, 5-foot visibility, 1- to 1.5-foot waves	

8.6.1.7 Maintenance Effort # 3

Visual observations for water quality were collected periodically before, during, and after completion of the berm maintenance effort. Water quality in the nearshore, or between the shoreline and the reef crest offshore, varied significantly along the shoreline. After the initial placement, fines were observed in the nearshore, however, offshore conditions beyond the reef crest appeared to be ubiquitous (Figure 8-18-Figure 8-20, Table 8-5). Offshore water quality was noticeably clearer directly offshore of the reef crest. Observations of the nearshore waters at Sugar Cove, Baldwin Beach, and Laulea (the western cove abutting Sugar Cove) are presented in Table 8-5.

Figure 8-21. Water quality conditions at Sugar Cove, 10:16 on September 16, 2020

Figure 8-22. Water quality conditions at Sugar Cove, 12:07 on September 16, 2020

Figure 8-23. Water quality conditions at Sugar Cove, 13:44 on September 16, 2020

Figure 8-24. Water quality conditions at Sugar Cove, 14:16 on September 17, 2020

Table 8-10 Water quality observations during maintenance #3 efforts.

Date - Time	Sugar Cove Nearshore	Baldwin Beach Nearshore	Laulea Nearshore
2020/09/16 – 1000	Nearshore visibility is about 2 feet.	Heavy erosion	
2020/09/16 – 1100	Increasing winds, wave heights, and turbidity	White plume moving down the coast from Baldwin	Incoming turbidity from the east
2020/09/16 - 1200	Collected water samples for turbidity test		
2020/09/16 - 1305	Turbidity moving in from Baldwin area and increasing all afternoon.	Continued erosion of the park and suspension of fine carbonates. White turbidity signature along coastline.	Heavy erosion on the east and west ends. Brown and red turbidity is mixing with the white. Not as "bright" as Baldwin, but visibility is less than 1 foot – very bad nearshore.

8.6.1.8 Maintenance Effort # 4

Visual observations for water quality were collected periodically before, during, and after completion of the berm maintenance effort. Water quality in the nearshore, or between the shoreline and the reef crest offshore, varied significantly along the shoreline. After the initial placement, fines were observed in the nearshore, however, offshore conditions beyond the reef crest appeared to be ubiquitous (Figure 8-25 to Figure 8-28, Table 8-11). Offshore water quality was noticeably clearer directly offshore of the reef crest. Observations of the nearshore waters at Sugar Cove, Baldwin Beach, and Laulea (the western cove abutting Sugar Cove) are presented in Table 8-11.

Figure 8-25. Water quality conditions at Sugar Cove (morning, September 28, 2021)

Figure 8-26. Water quality conditions at Sugar Cove (midday, September 28, 2021)

Figure 8-27. Water quality conditions at Sugar Cove (afternoon, September 28, 2021)

Figure 8-28. Water quality conditions at Sugar Cove (end of day, September 28, 2021)

Table 8-11: Water quality observations during maintenance #4 efforts

Date - Time	Sugar Cove Nearshore	Baldwin Beach Nearshore	Laulea Nearshore
2021/09/28 – 0700	Winds are 15 mph to the East, moderate regional turbidity	Moderate turbidity near the shoreline, patchy water quality in the nearshore	Moderate turbidity near the shoreline, patchy water quality in the nearshore
2021/09/28 – 0930	Nearshore visibility is about 3 feet. Patchy turbidity mostly offshore		
2021/09/28 – 1030-1130	Collected water samples, low visibility		
2021/09/28 - 1520	No changes to turbidity		

8.6.1.9 Post-Maintenance Effort # 4

Visual observations for water quality were collected periodically throughout the day. Water quality in the nearshore, or between the shoreline and the reef crest offshore, was clear in the morning and began getting more turbid as wave activity increased (Figure 8-25 to Figure 8-28, Table 8-11). Observations of the nearshore waters at Sugar Cove, Baldwin Beach, and Laulea (the western cove abutting Sugar Cove) are presented in Table 8-11.

Figure 8-29. Water quality conditions at Sugar Cove (morning, May 11, 2023)

Figure 8-30. Water quality conditions at Sugar Cove (midday, May 11, 2023)

Figure 8-31. Water quality conditions at Sugar Cove (afternoon, May 11, 2023)

Figure 8-32. Water quality conditions at Sugar Cove (end of day, May 11, 2023)

Table 8-12: Water quality observations during field visit on May 11, 2023

Date – Time	Sugar Cove Nearshore	Baldwin Beach Nearshore	Specklesville (Laulea) Nearshore
2023/05/11 – 0900	Winds 3.45 mph to 240°. Waves 4.86 feet, 5.23 sec, from 80°. Nearshore visibility is about 10 feet.		
2023/05/11 – 1200	Collected water samples. Winds 20.71 mph to 30°. Waves 4.72 feet, 5.98 sec, from 16°. Nearshore visibility is about 3 feet. Moderate turbidity near the shoreline.		
2023/05/11 – 1300		Collected water samples. Winds 20.71 mph to 30°. Waves 4.59 feet, 6.1 sec, from 63°. High turbidity near the shoreline.	
2023/05/11 – 1330			Collected water samples. Winds 13.81 mph to 40°. Waves 4.4 feet, 6.09 sec, from 75°. Moderate turbidity near the shoreline.
2023/05/11 - 1400	Wind speeds 19.76 mph and wave heights 4.49 feet. Increased turbidity and low visibility observed.		

8.6.2 Marine Benthic Conditions

Photographs collecting during the planning phase of the project are presented below (Figure 8-33to Figure 8-38), as indicative of general conditions within the cove. The cove has a restored nearshore sand field between the western rocky headland and the eastern seawalls. Outside of the cove a fossil carbonate pavement is emergent and covered with turf algae. The pavement is the dominant bottom type seaward of the cove, with a sand-filled channel extending from the nearshore sand fields to the reef crest. There are no live corals in the area near the cove.

No photographs of the ocean floor were collected immediately before, during, or after the maintenance efforts #1 or #2 due to poor visibility. Before maintenance #3, videos of the benthic environment were taken along transects 1, 3, 5 and 7. Along profile 5, the nearshore rocks were almost completely covered with a nearshore sand bar. Very few fish were observed along the transect lines.

On May 11, 2023, a site visit was conducted to monitor the existing conditions. Photographs of the marine benthic habitat are presented below (Figure 8-33 to Figure 8-38), as indicative of general conditions within the cove. The cove has a healthy nearshore sand field between the rocky headlands. On the edges of the cove a fossil carbonate pavement is emergent and covered with turf algae, reef fish, and lobsters. One green sea turtle was observed on the beach at the time of the site visit with six additional sand tracks from where turtles had hauled out previously since the last high tide.

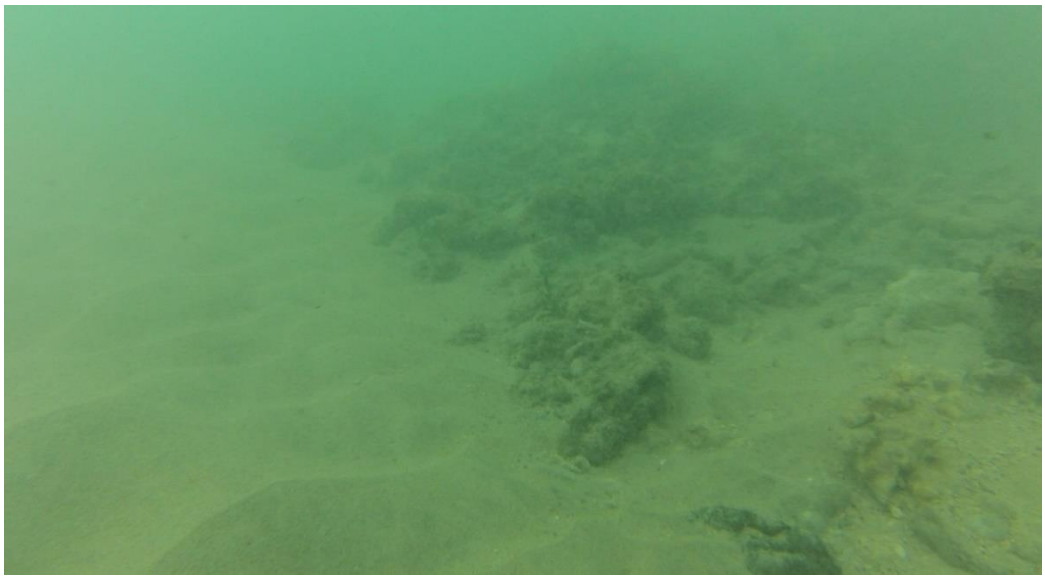


Figure 8-33. Sand and pavement substrates representative of the central area within the cove

Figure 8-34. Sand substrate representative of the nearshore sand field

Figure 8-35. Nearshore sand from the sand bar similar to the restored beach sand

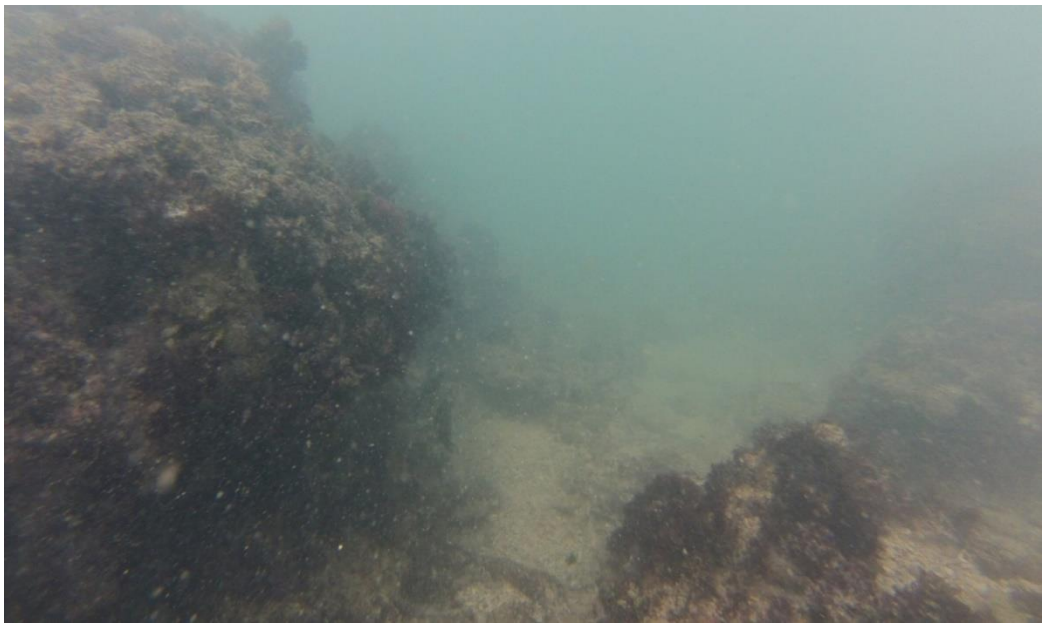


Figure 8-36. Turf algae and hard bottom representative of the eastern portion of the cove

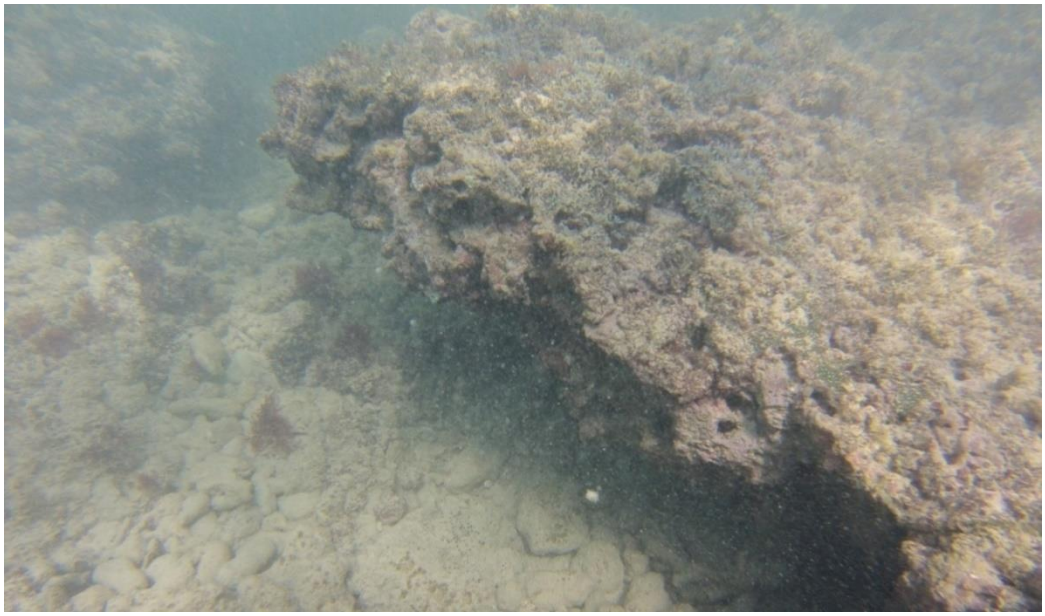


Figure 8-37. Turf algae, hard bottom, and cobble representative of offshore of the center of the cove

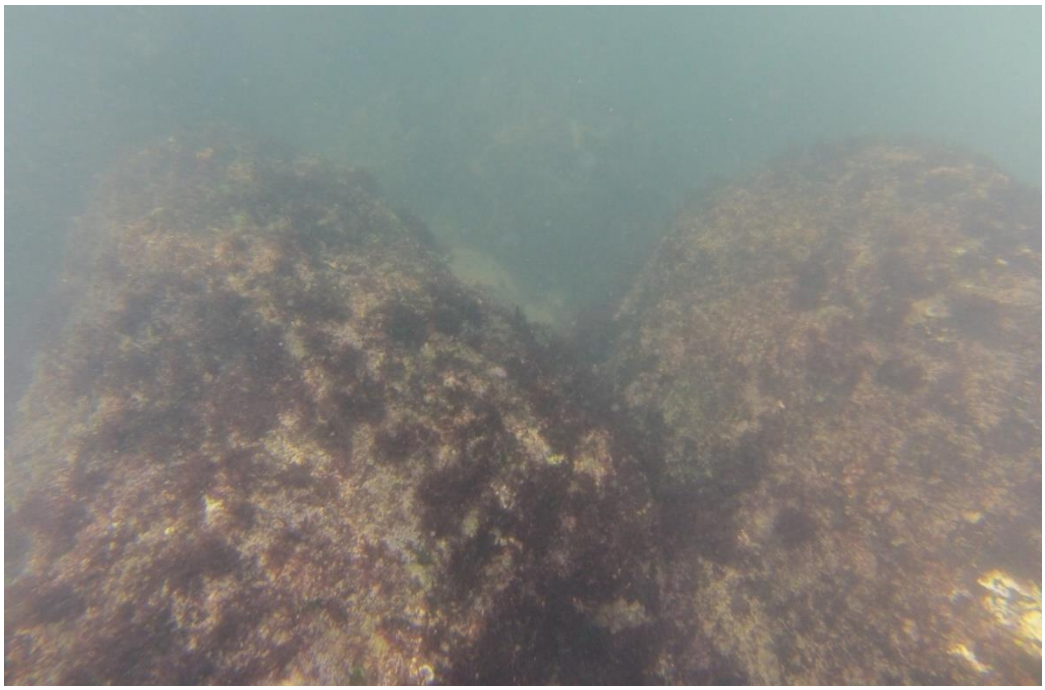


Figure 8-38. Turf algae, hard bottom, and boulders representative of the western side of the cove

Figure 8-39. Sea turtle observed on the beach at Sugar Cove on May 11, 2023

Figure 8-40. Sand substrate observed in the nearshore region of the middle of the cove

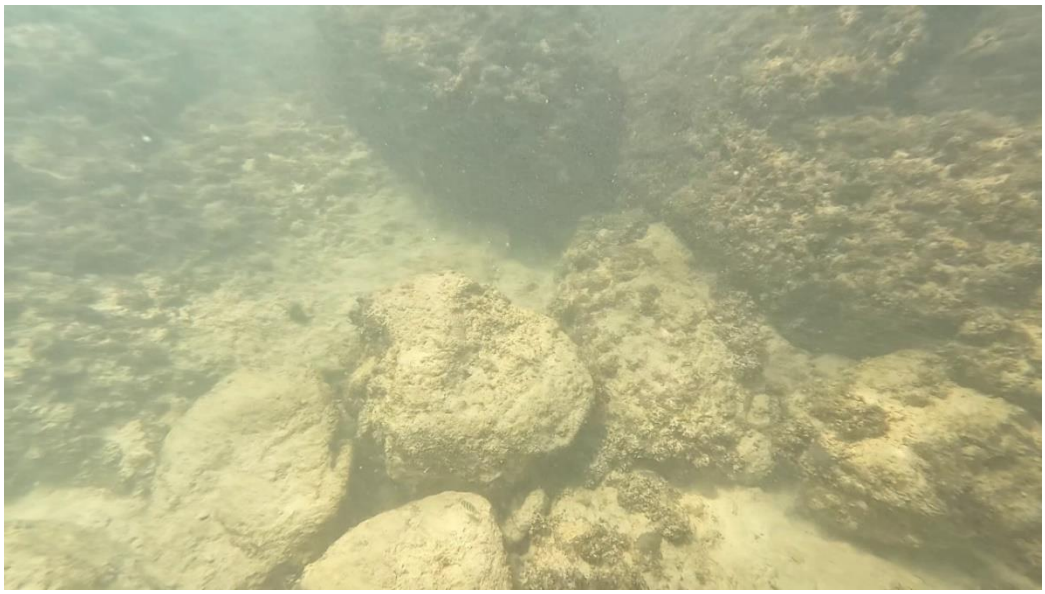


Figure 8-41. Typical rocky bottom observed offshore of Sugar Cove beach

Figure 8-42. Lobster observed at the outer boundary of Sugar Cove

8.6.3 Water Quality Data

Water quality was assessed at three locations at the beginning and end of the berm maintenance project and as part of the ongoing monitoring. A Hach 2100Q Turbidimeter was used for the testing and is calibrated before use.

Water quality results, as presented in Table 8-13 through Table 8-21 and are reflective of changes in wave energy, rain, and regional turbidity as observed during the project. During maintenance #1 lower turbidity readings were recorded at both Sugar Cove and Baldwin Beach following the berm maintenance activity, indicating a regional decrease likely associated with decreasing winds and waves during the sampling period. It is unknown why there was an increase in turbidity at the Sprecklesville control site during the project.

For maintenance #2 Sugar Cove was more turbid than Baldwin Beach and less turbid than Sprecklesville. At the end of the project, Sugar Cove was the most turbid water quality site.

For maintenance #3, Spreckelsville was the most turbid every recorded since 2015 when this project began. This is likely due to the erosion occurring there. Baldwin Beach was also found to have a high turbidity. Sugar Cove had a small amount of turbidity that is comparable to what has been observed during previous site visits.

For maintenance #4, all sites were noted as average turbidity in respect to the previous maintenance project records. Baldwin Beach had the most turbid water quality at the project site.

Table 8-13 Water Turbidity Results: November 09, 2015, at 07:45 (Maintenance #1)

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	5.28
Baldwin Beach	7.12
Sprecklesville	8.95

Table 8-14 Water Turbidity Results: November 10, 2015, at 14:00 (Maintenance #1)

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	2.64
Baldwin Beach	4.96
Sprecklesville	10.96

Table 8-15 Water Turbidity Results: September 06, 2016, at 10:00 (Maintenance #2)

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	13.5
Baldwin Beach	42.2
Sprecklesville	7.7

Table 8-16 Water Turbidity Results: September 07, 2016, at 17:00 (Maintenance #2)

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	5.5
Baldwin Beach	4.8
Sprecklesville	8.1

Table 8-17 Water Turbidity Results: March 14, 2017, at 11:00

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	3.30
Baldwin Beach	2.51
Sprecklesville	2.69

Table 8-18 Water Turbidity Results: October 05, 2017, at 11:10

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	5.98
Baldwin Beach	20.6
Sprecklesville	8.00

Table 8-19 Water Turbidity Results: January 22, 2019, at 13:00

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	3.17
Baldwin Beach	4.45
Sprecklesville	2.57

Table 8-20 Water Turbidity Results: May 22, 2019, at 15:15

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	0.53
Baldwin Beach	1.33
Sprecklesville	1.02

Table 8-21 Water Turbidity Results: September 16, 2020, at 13:05 (Maintenance #3)

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	4.8
Baldwin Beach	12.8
Sprecklesville	26.1

Table 8-22: Water Turbidity Results: September 28, 2021, at 12:00 (Maintenance #4)

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	4.25
Baldwin Beach	11.9
Sprecklesville	6.08

Table 8-23: Water Turbidity Results: May 11, 2023, at 12:00 (Post Maintenance #4)

Location	Turbidity (NTU) (average of 3 readings)
Sugar Cove	2.81
Baldwin Beach	14.0
Sprecklesville	3.05

8.7 Beach Profile Adjustments

Profiles and topographic data were collected immediately before and after berm maintenance efforts. Berm maintenance sand was placed along a nearly 300-foot length of the beach, between approximately 3 + 25 to approximately 7 + 25. The base of placed material was at elevations greater than +5 feet at all locations, and had crest elevations around +12 feet, in conformance with the placement plan.

8.7.1 Beach Maintenance # 1 Winter 2015

Data were collected in the morning on November 09, 2015, prior to sand placement (Figure 8-43), and again in the afternoon on November 10, 2015, immediately following sand placement (Figure 8-44). Data for the second maintenance were collected on the morning of September 6, 2016, and again in the afternoon of September 7, 2016. Representative profiles are presented for station 4 + 00 (Figure 8-45) through station 8 + 00 (Figure 8-53).

Station 4 + 00, station 6 + 00, and station 7 + 50 are representative of Transect 7, Transect 5, and Transect 3, respectively. Placement grades are visible in the profile data presented below.

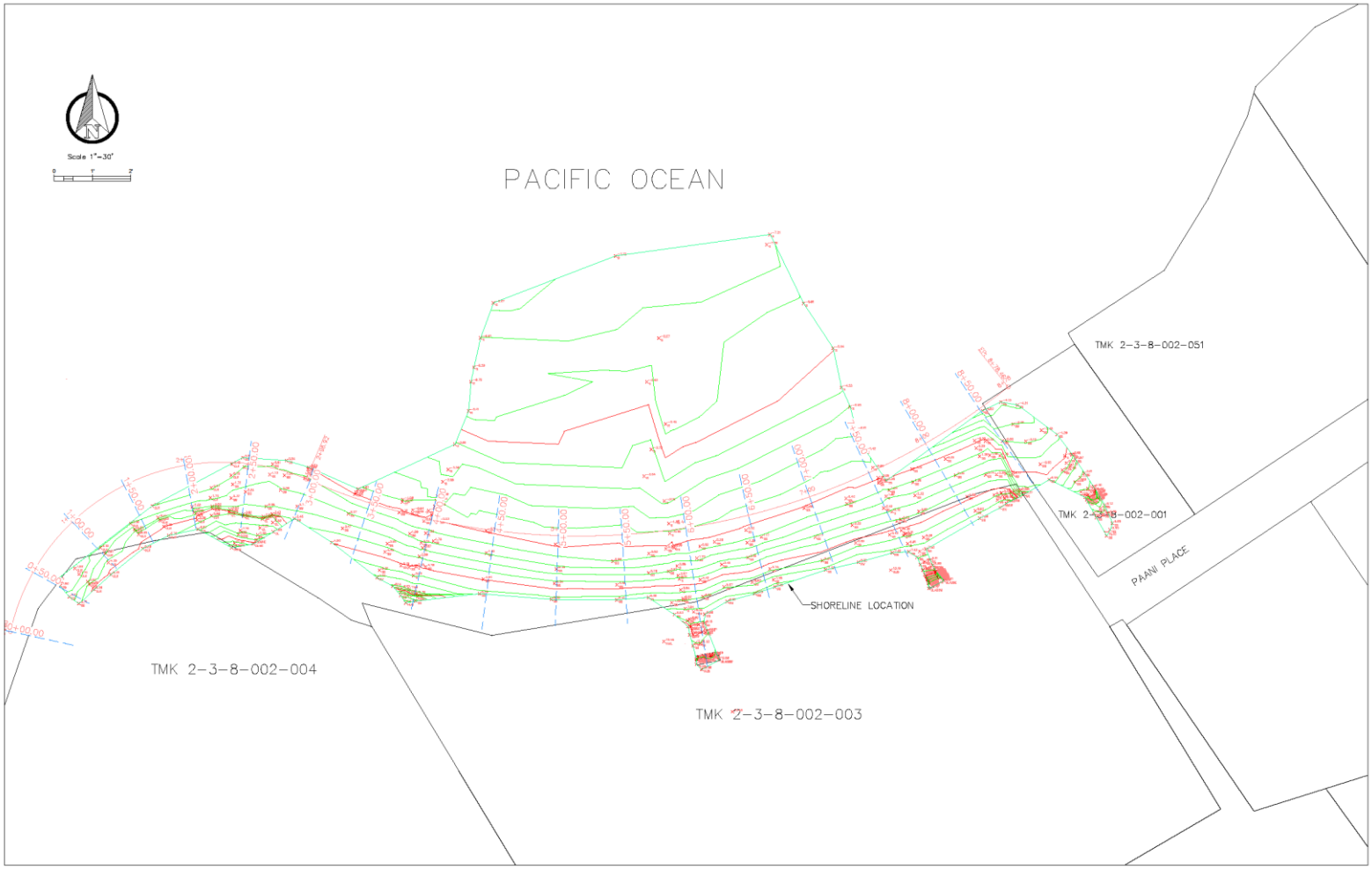


Figure 8-43. November 09, 2015 topography prior to initiating berm maintenance #1

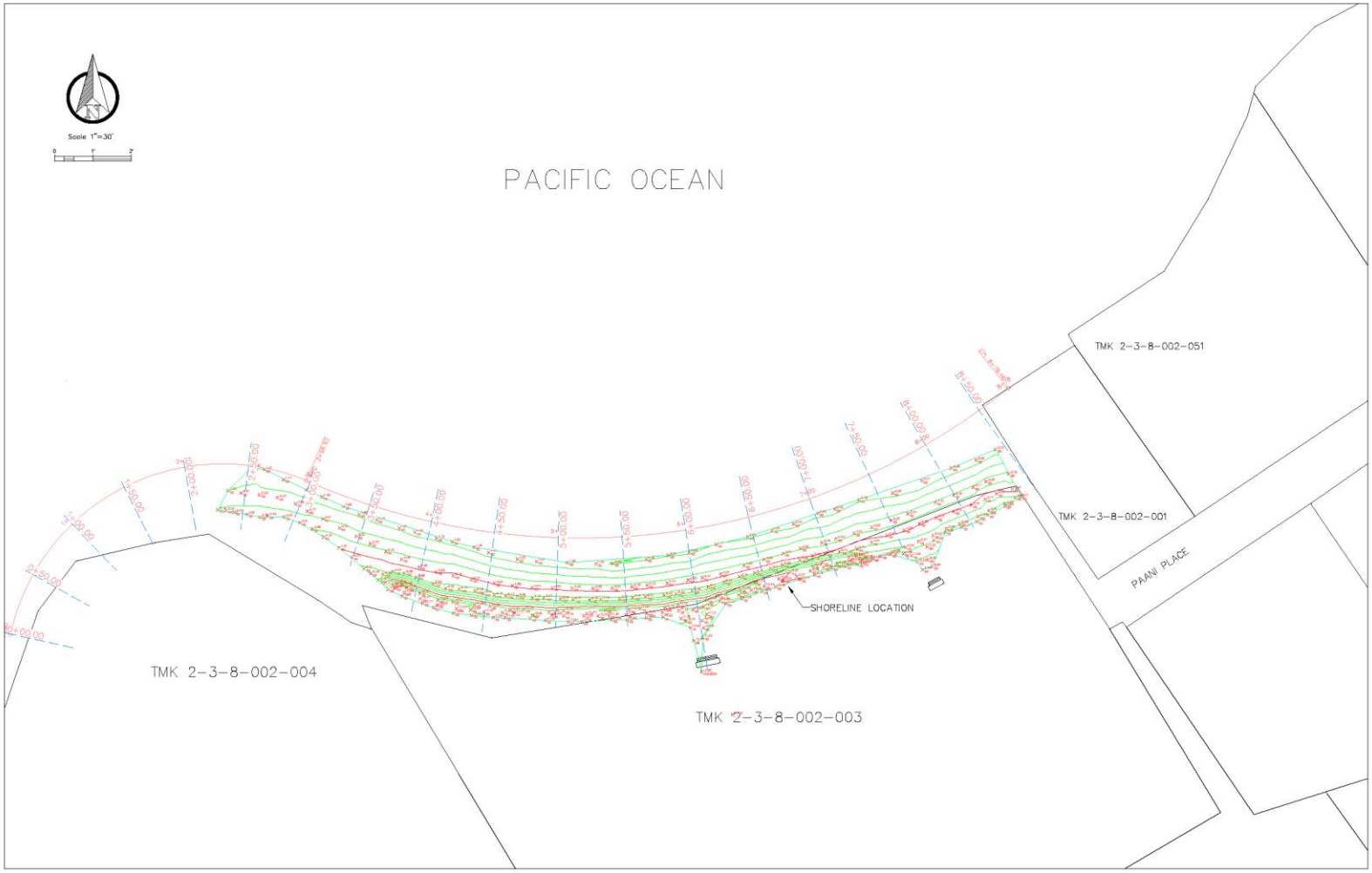


Figure 8-44. November 10, 2015 topography immediately following berm maintenance #1

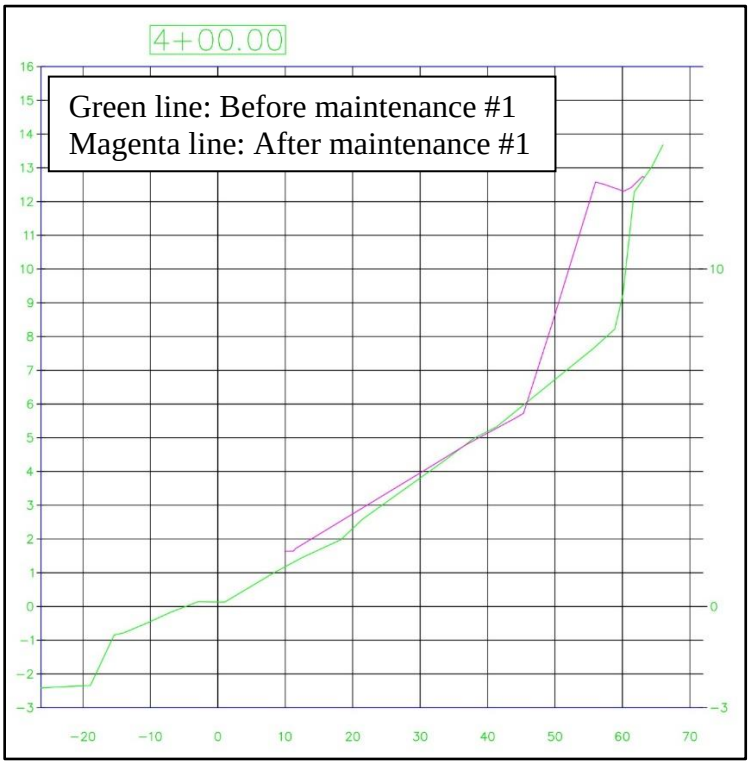


Figure 8-45. Sugar Cove beach profile 4+00 beach maintenance #1

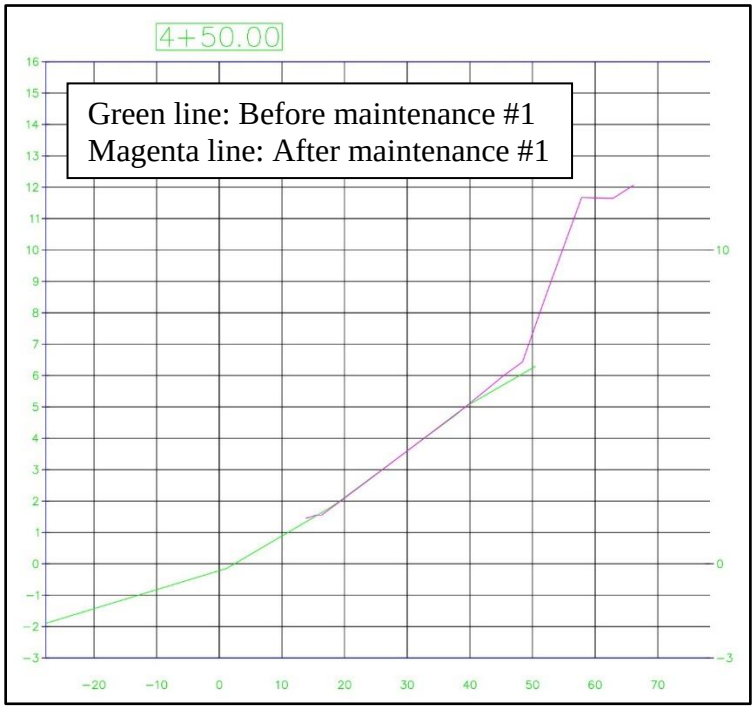


Figure 8-46. Sugar Cove beach profile 4+50 beach maintenance #1

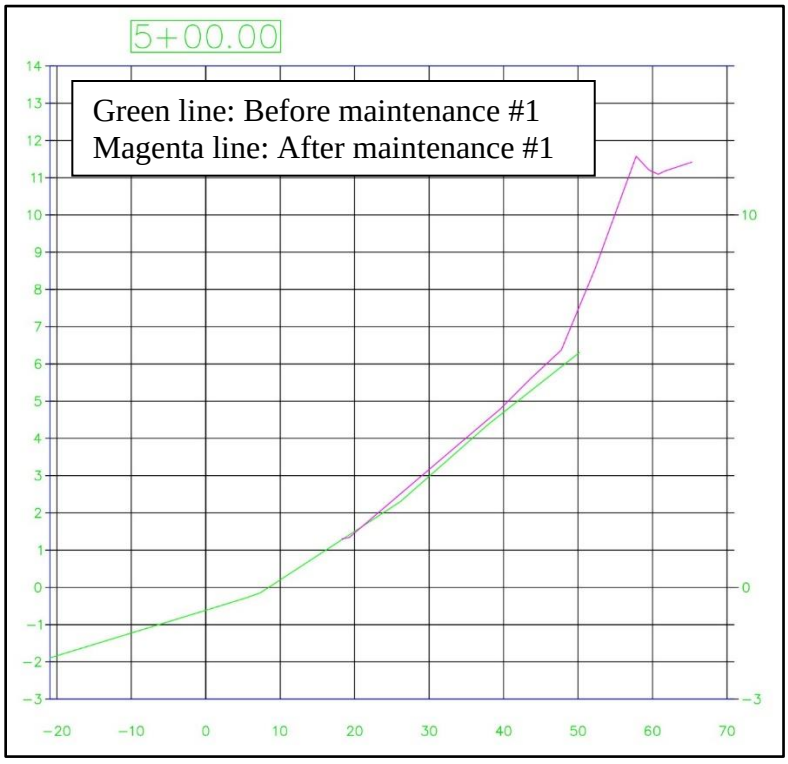


Figure 8-47. Sugar Cove beach profile 5+00 beach maintenance #1

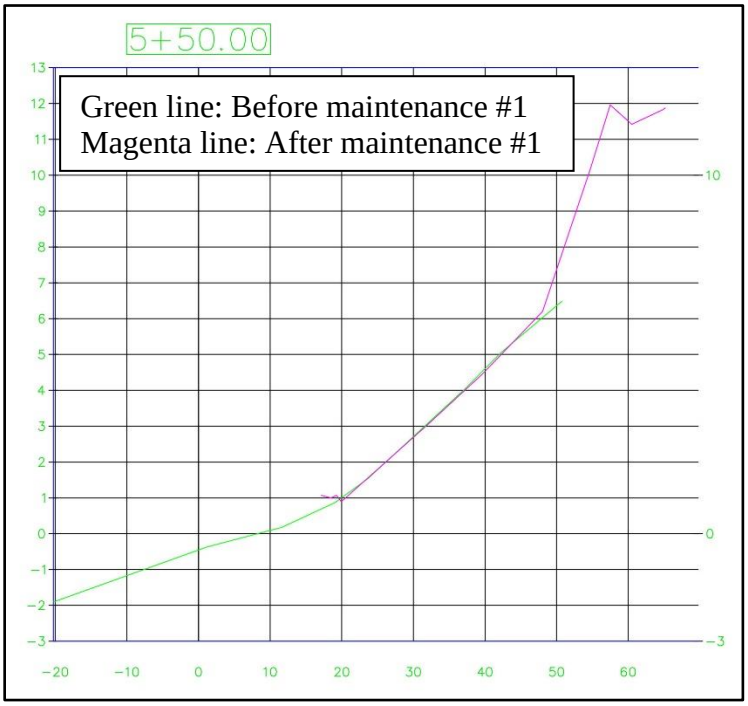


Figure 8-48. Sugar Cove beach profile 5+50 beach maintenance #1

Figure 8-49. Sugar Cove beach profile 6+00 beach maintenance #1

Figure 8-50. Sugar Cove beach profile 6+50 beach maintenance #1

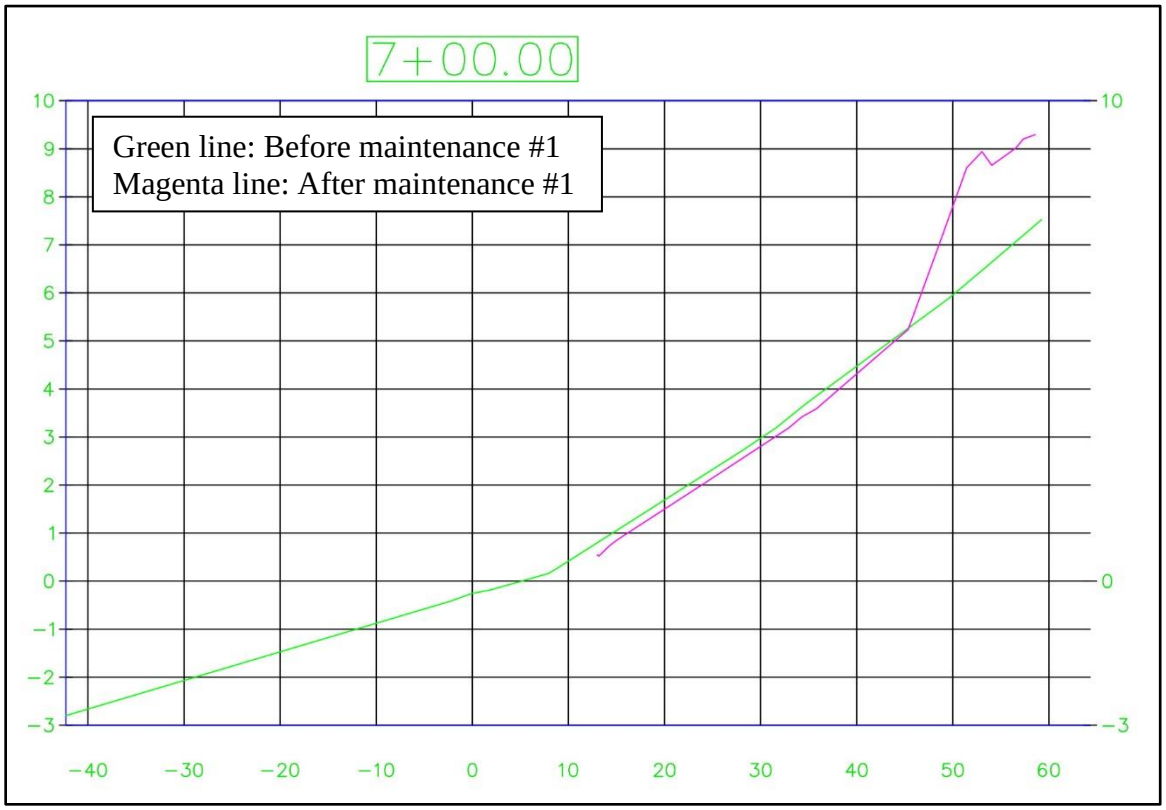


Figure 8-51. Sugar Cove beach profile 7+00 beach maintenance #1

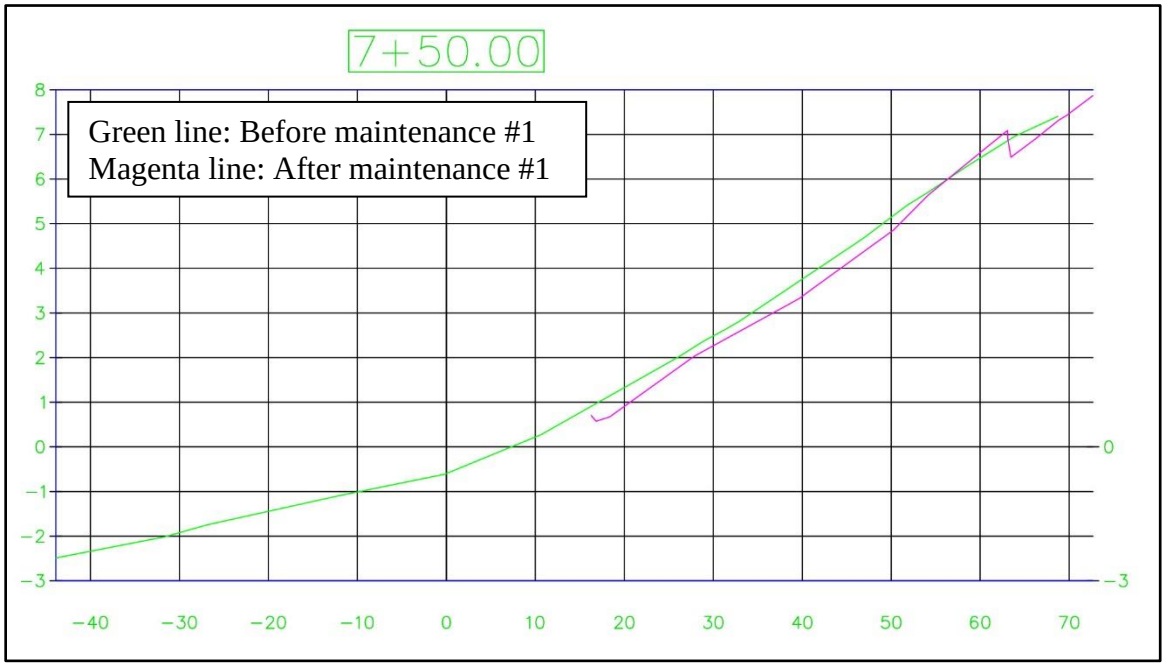


Figure 8-52. Sugar Cove beach profile 7+50 beach maintenance #1

Figure 8-53. Sugar Cove beach profile 8+00 beach maintenance #1

Berm maintenance material was heavily attacked during the consequent winter months by exceptionally large and frequent wave events associated with the 2015 – 2016 El Nino.

8.7.2 Beach Maintenance # 2 Fall 2016

Data were collected in the morning on September 06, 2016, prior to sand placement (Figure 8-43), and again in the afternoon on September 07, 2016, immediately following sand placement (Figure 8-55). Data for the second maintenance were collected on the morning of September 6, 2016, and again in the afternoon of September 7, 2016. Representative profiles are presented for station 4 + 00 (Figure 8-56) through station 8 + 00 (Figure 8-64). Station 4 + 00, station 6 + 00, and station 7 + 50 are representative of Transect 7, Transect 5, and Transect 3, respectively. Placement grades are visible in the profile data presented below, and represent 892 cubic yards of material placed during the maintenance operation.

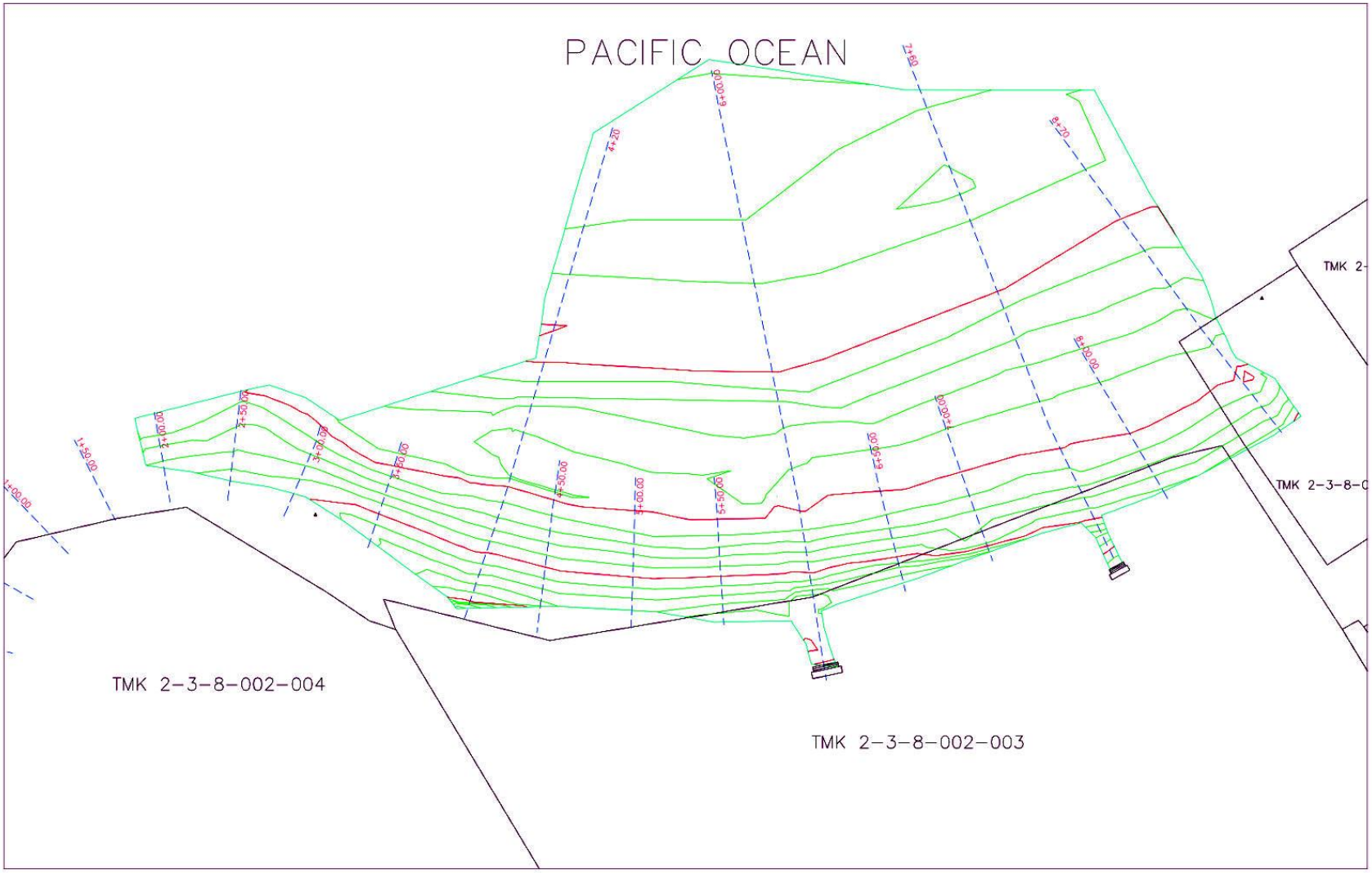


Figure 8-54. September 06, 2016 topogrpahy prior to initiating berm maintenance #2

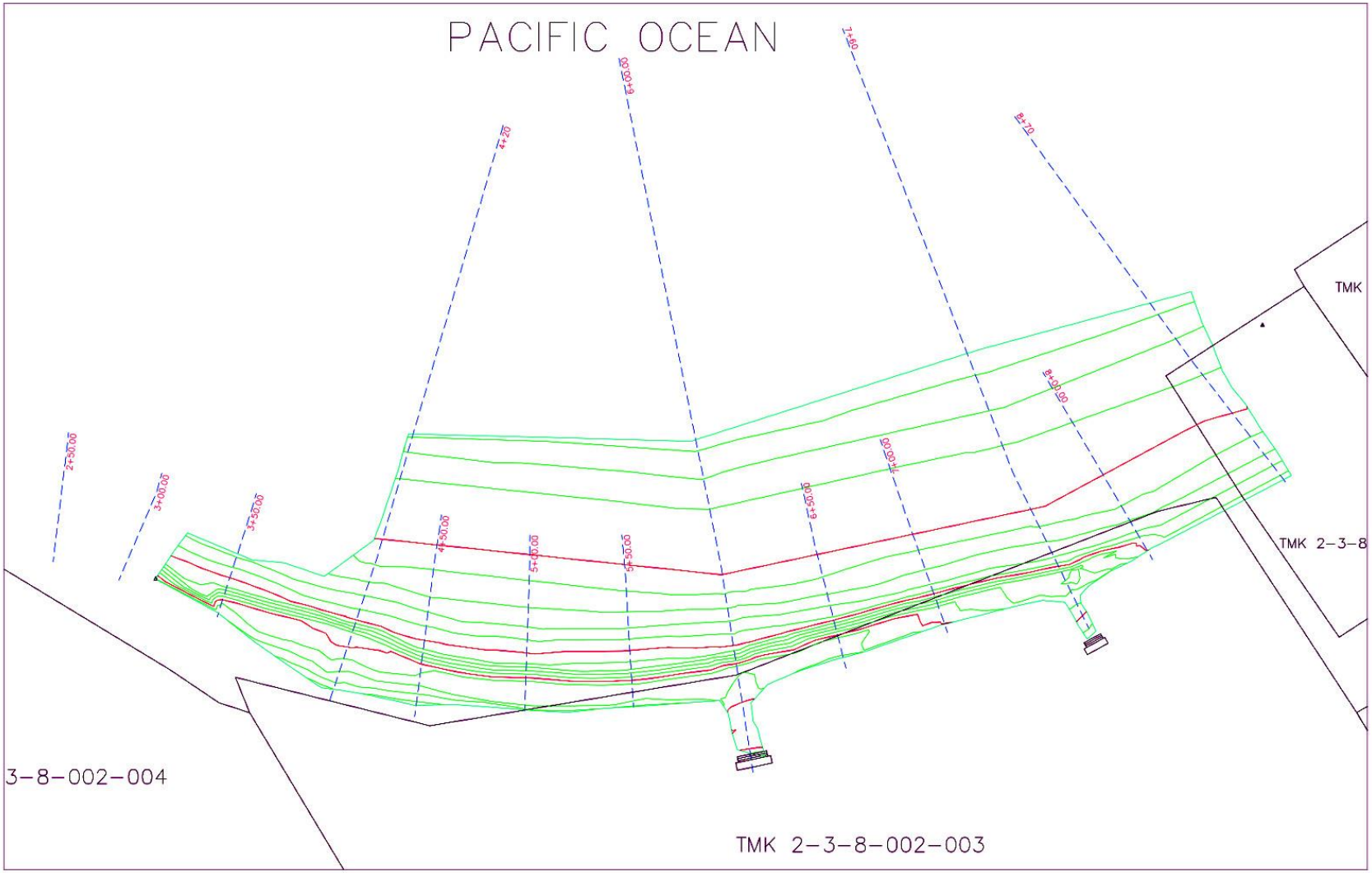


Figure 8-55. September 7, 2016 topography immediately following berm maintenance #2

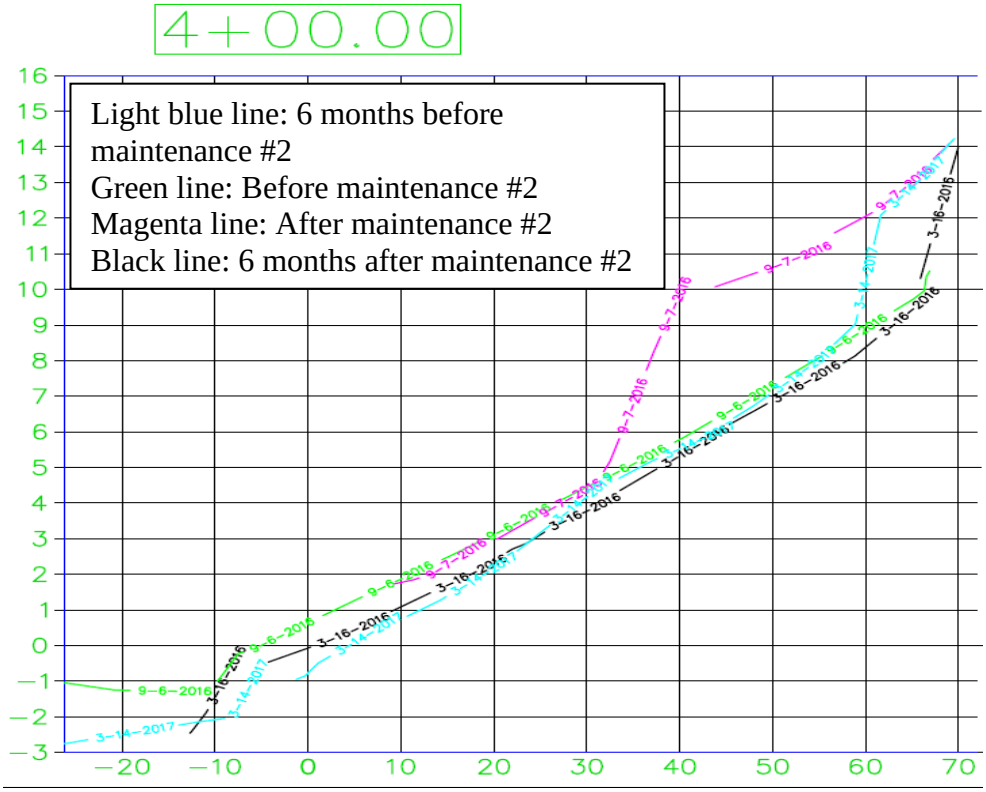


Figure 8-56. Sugar Cove beach profile 4+00 beach maintenance #2

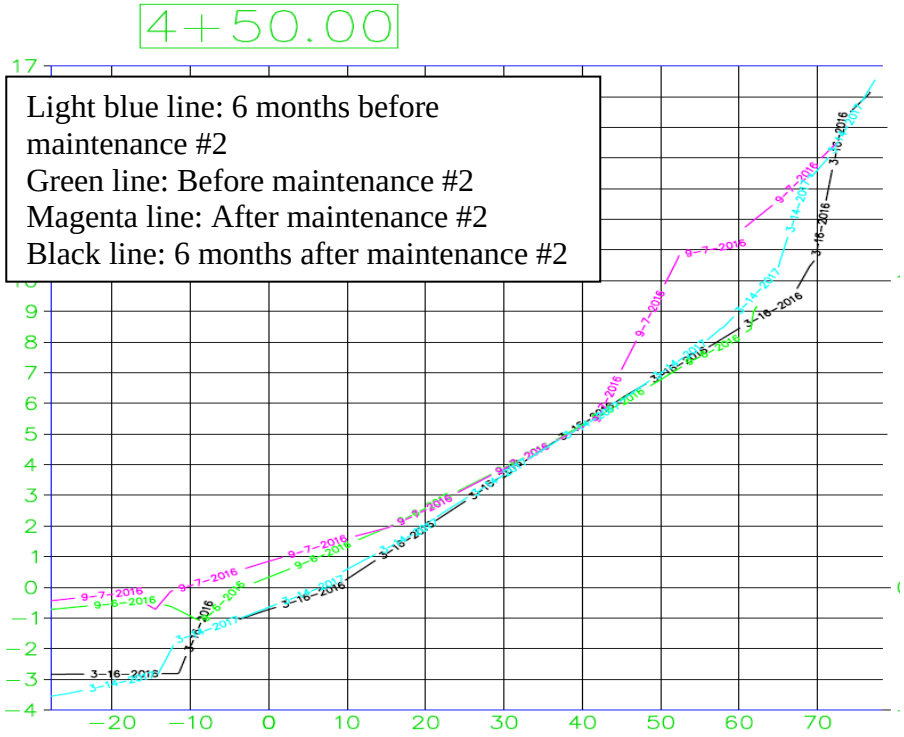


Figure 8-57. Sugar Cove beach profile 4+50 beach maintenance #2

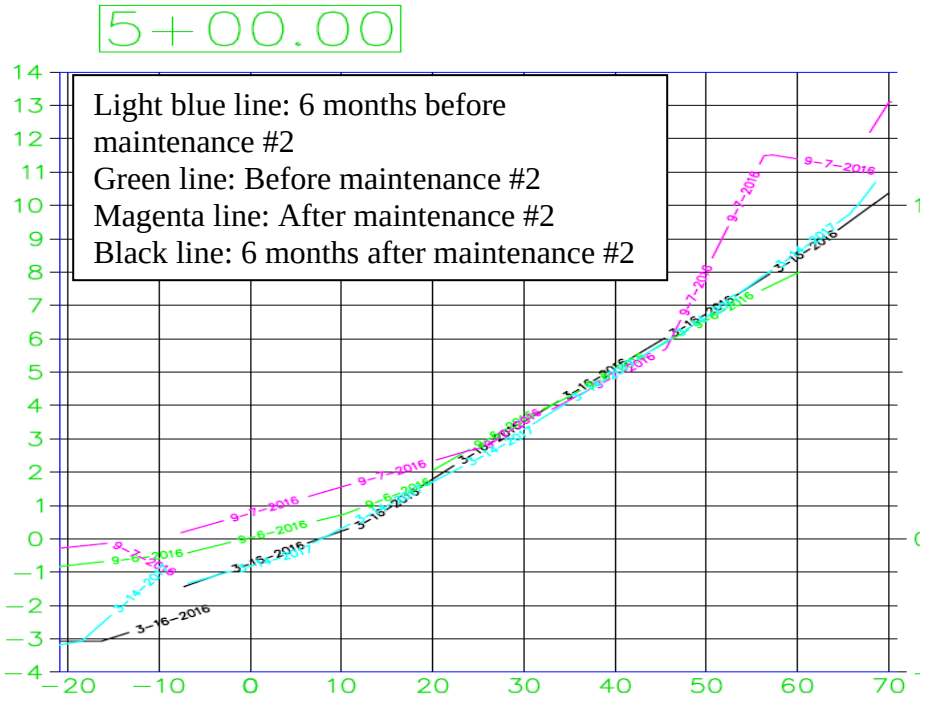


Figure 8-58. Sugar Cove beach profile 5+00 beach maintenance #2

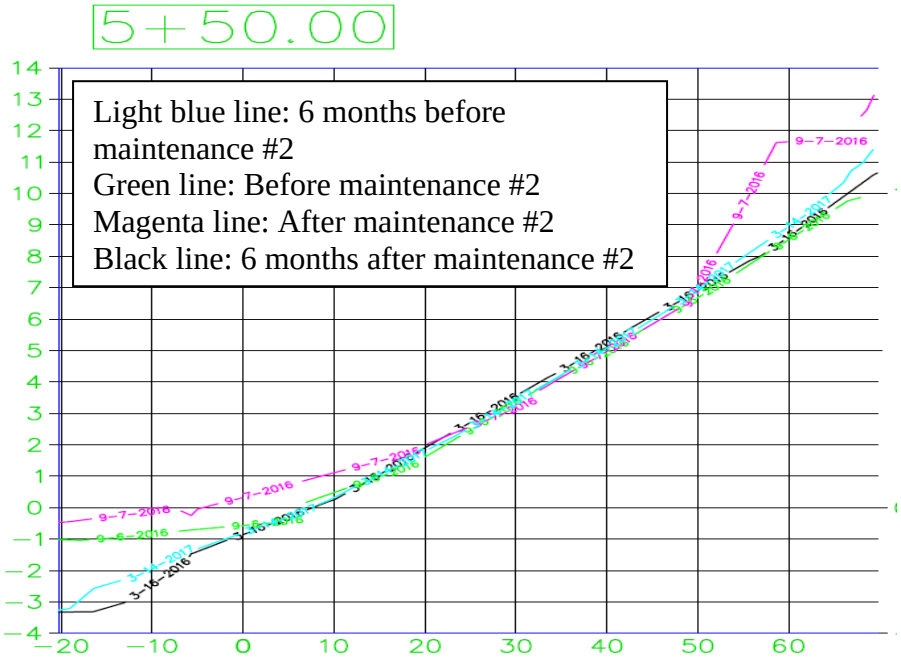


Figure 8-59. Sugar Cove beach profile 5+50 beach maintenance #2

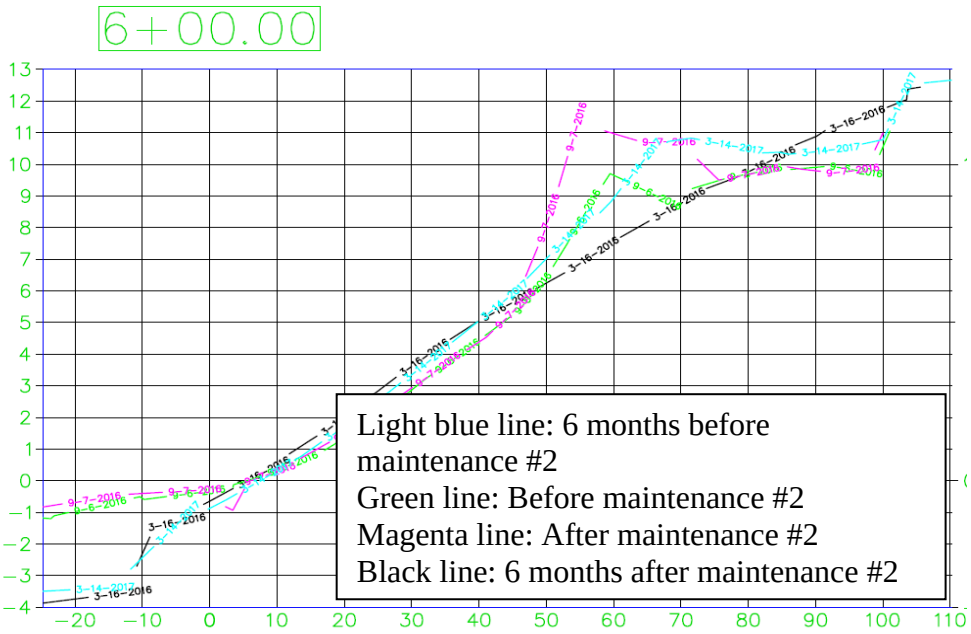


Figure 8-60. Sugar Cove beach profile 6+00 beach maintenance #2

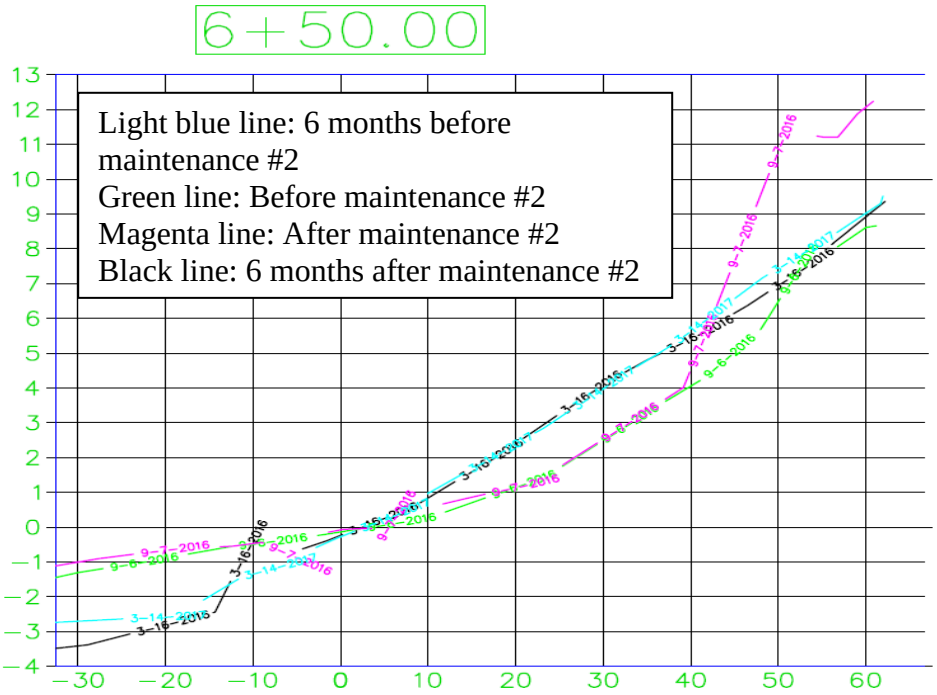


Figure 8-61. Sugar Cove beach profile 6+50 beach maintenance #2

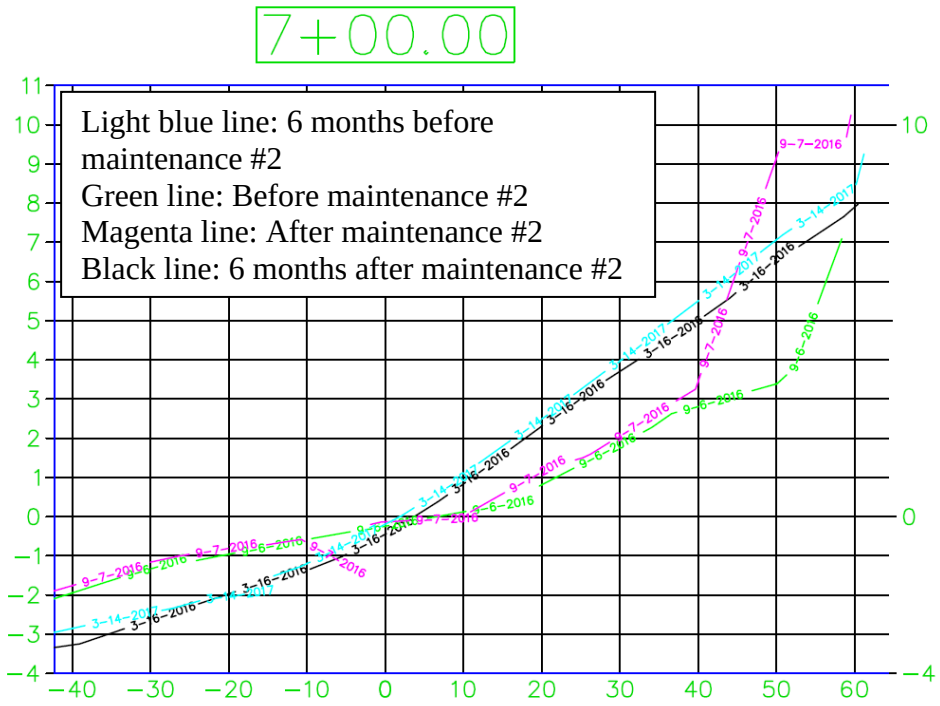


Figure 8-62. Sugar Cove beach profile 7+00 beach maintenance #2

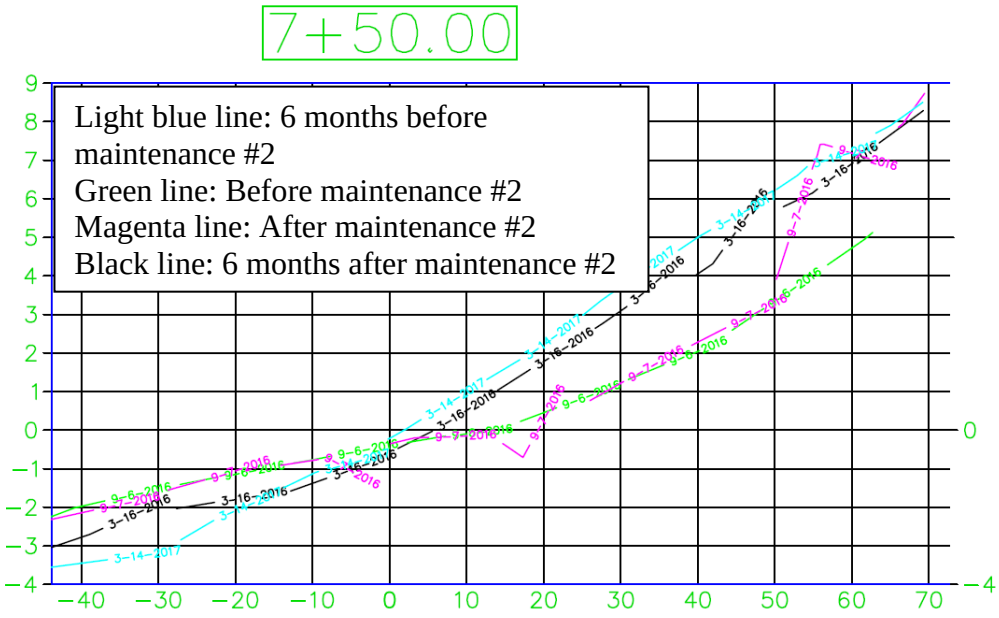


Figure 8-63. Sugar Cove beach profile 7+50 beach maintenance #2

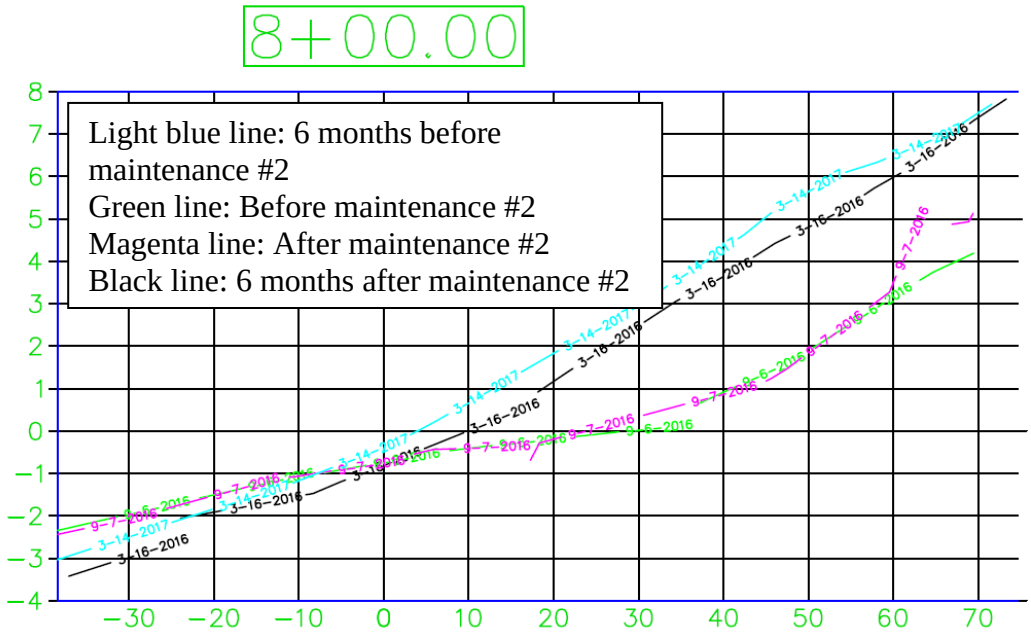


Figure 8-64. Sugar Cove beach profile 8+00 beach maintenance #2

8.7.3 Beach Maintenance # 3 Fall 2020

Data were collected in the morning on September 16, 2020, prior to sand placement (Figure 8-43), and again in the afternoon on September 18, 2020, immediately following sand placement (Figure 8-55). Representative profiles are presented for station 4 + 00 (Figure 8-56) through station 8 + 00 (Figure 8-64). Station 4 + 00, station 6 + 00, and station 7 + 50 are representative of Transect 7, Transect 5, and Transect 3, respectively. Placement grades are visible in the profile data presented below, and represent 892 cubic yards of material placed during the maintenance operation.

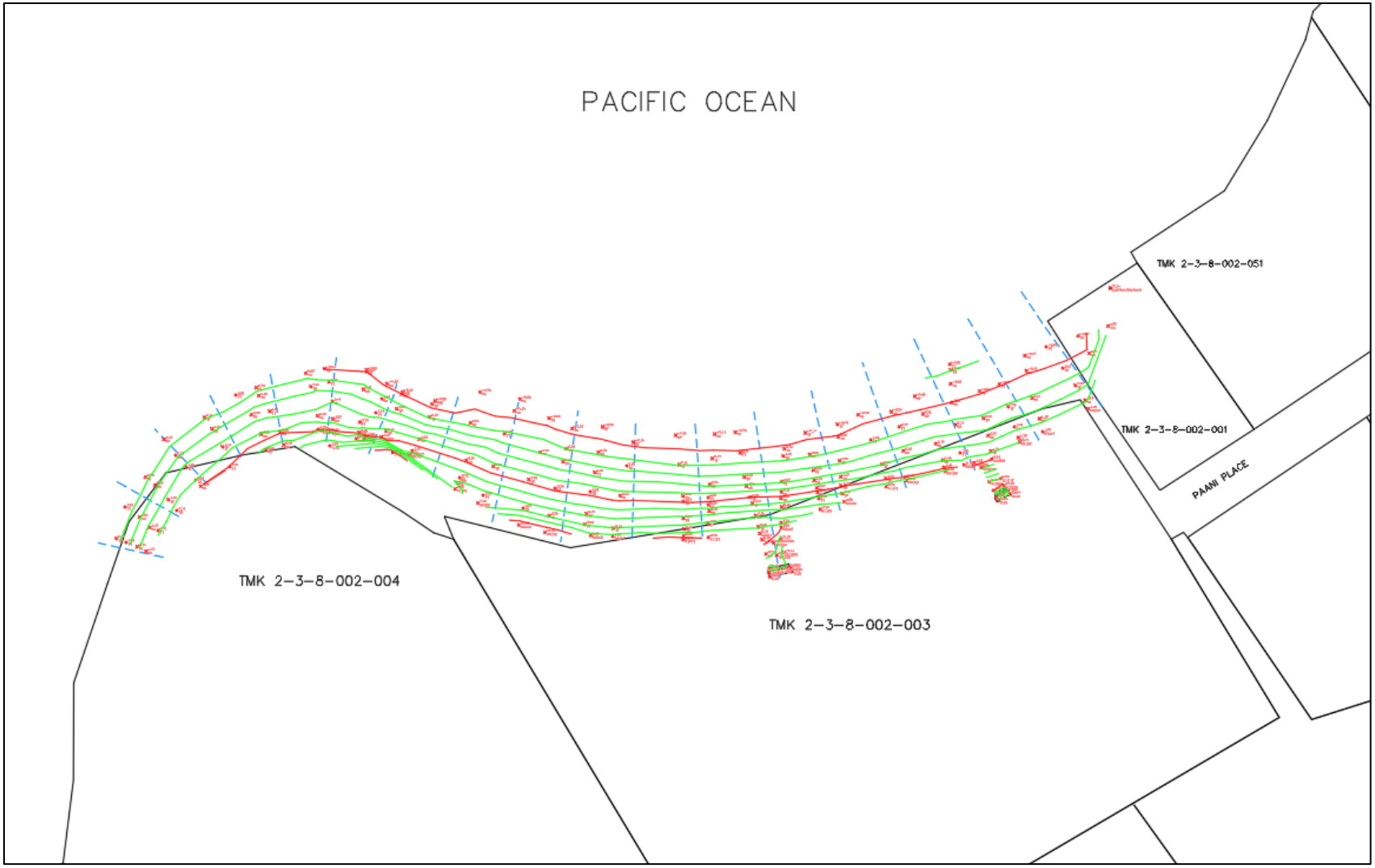


Figure 8-65. September 15, 2020 topography prior to initiating berm maintenance #3

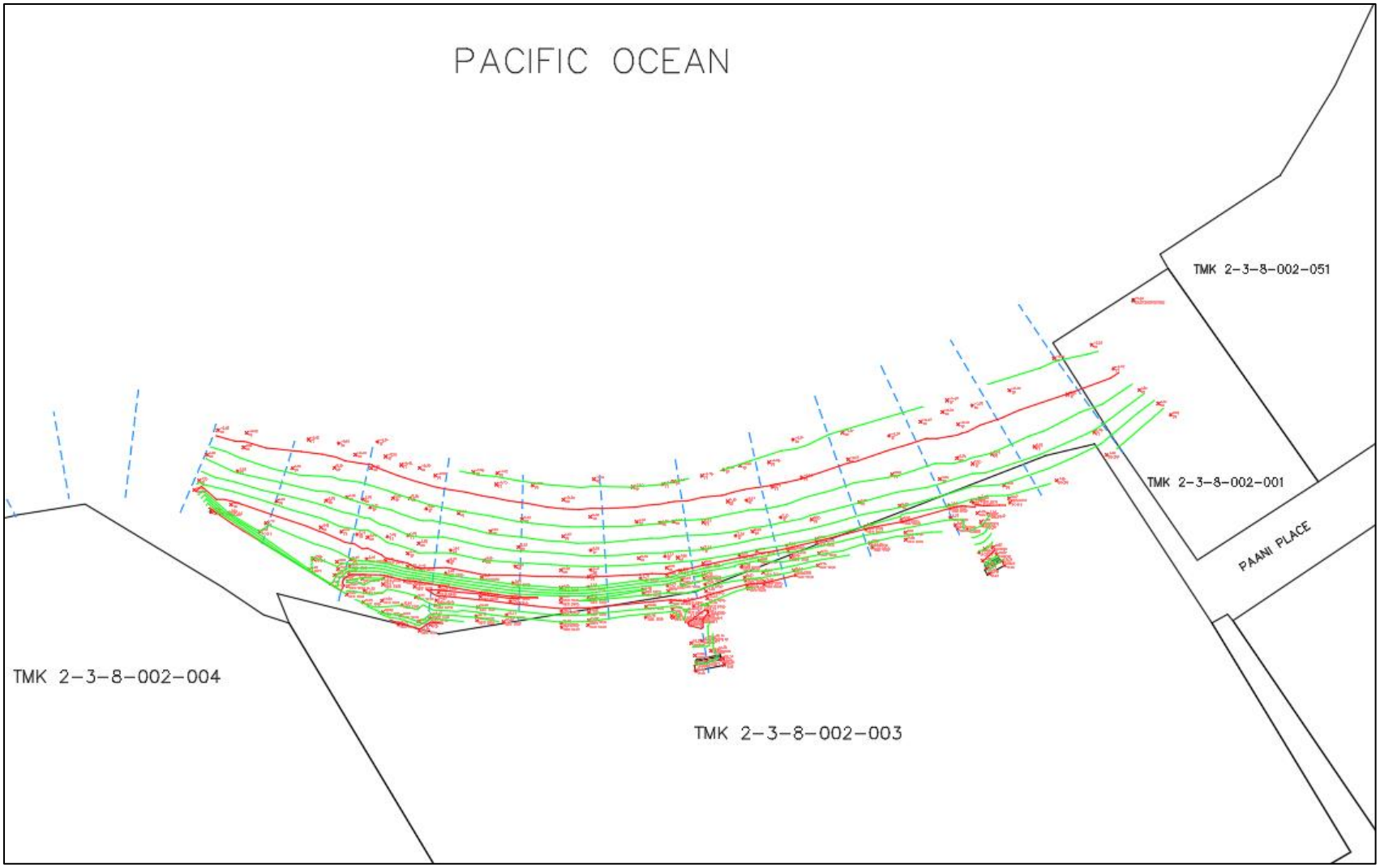


Figure 8-66. September 18, 2020 topography immediately following berm maintenance #3

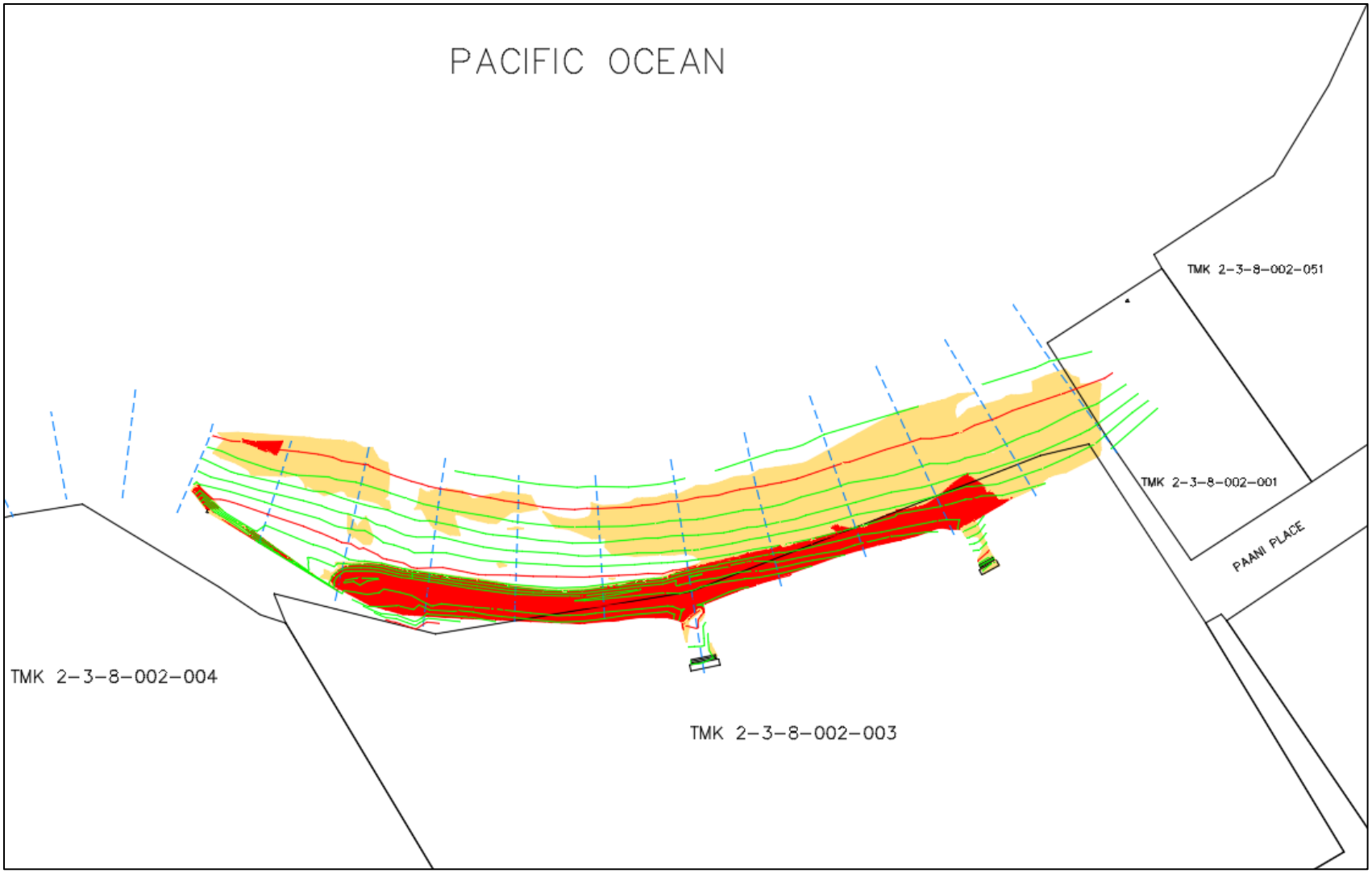


Figure 8-67. Comparison of September 15 and 18, 2020 topography showing where sand was placed during berm maintenance #3 in red

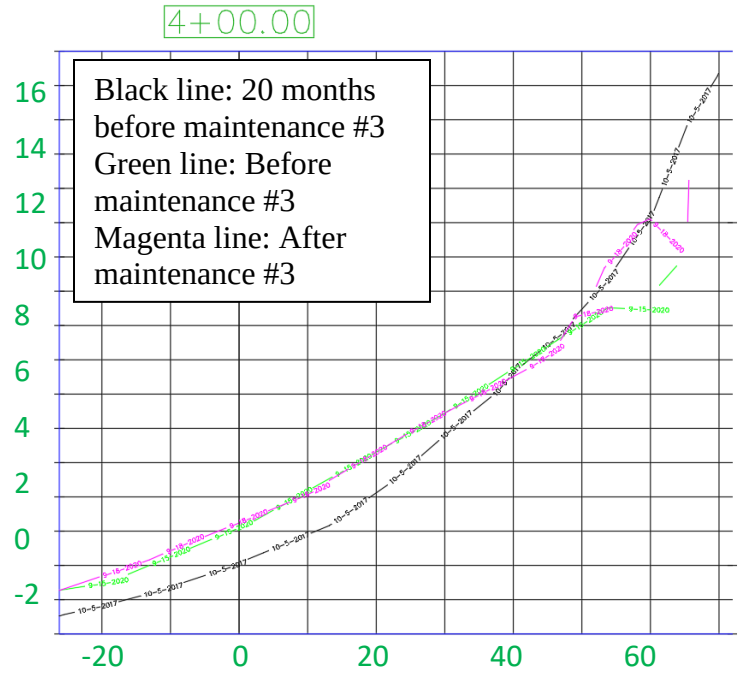


Figure 8-68. Sugar Cove beach profile 4+00 beach maintenance #3

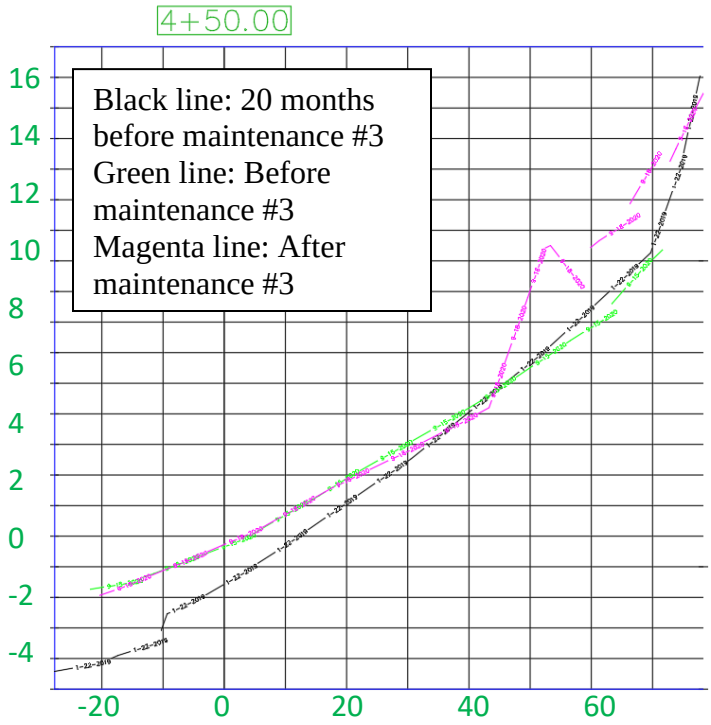


Figure 8-69. Sugar Cove beach profile 4+50 beach maintenance #3

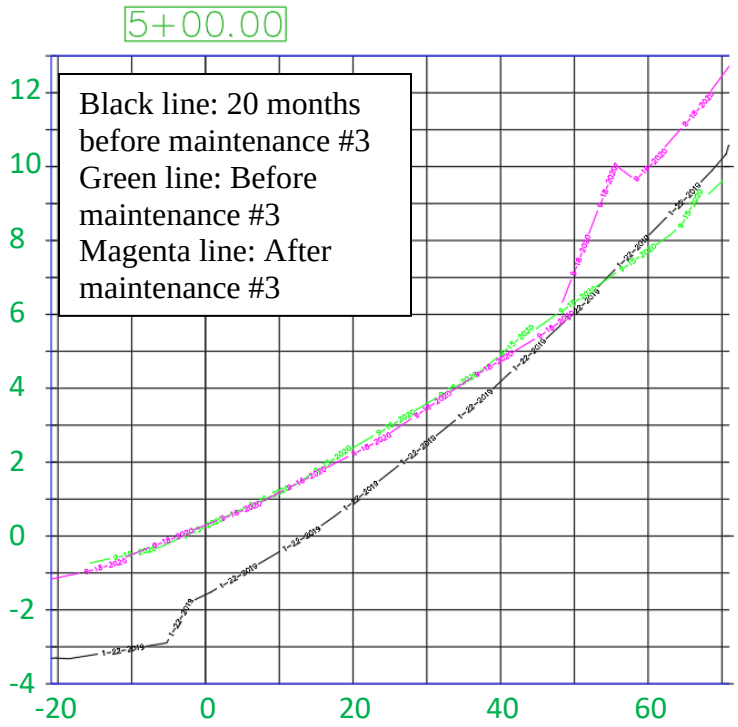


Figure 8-70. Sugar Cove beach profile 5+00 beach maintenance #3

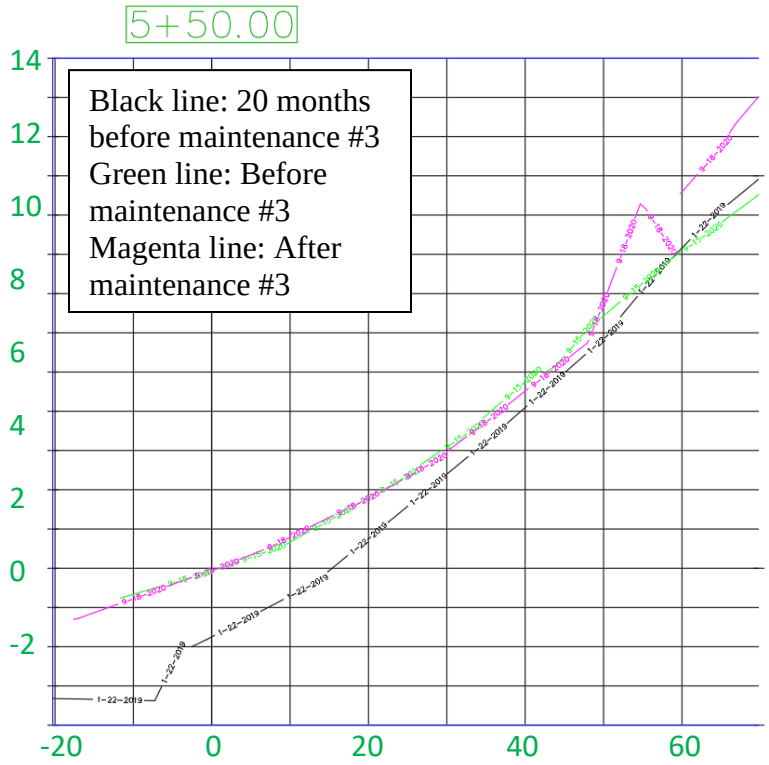


Figure 8-71. Sugar Cove beach profile 5+50 beach maintenance #3

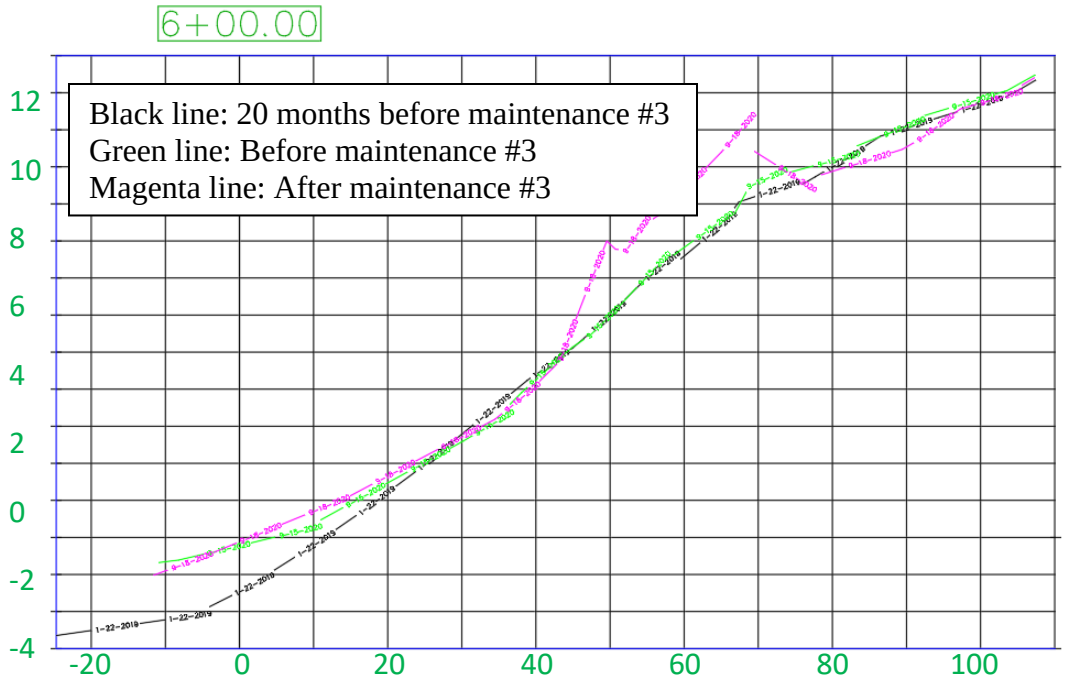


Figure 8-72. Sugar Cove beach profile 6+00 beach maintenance #3

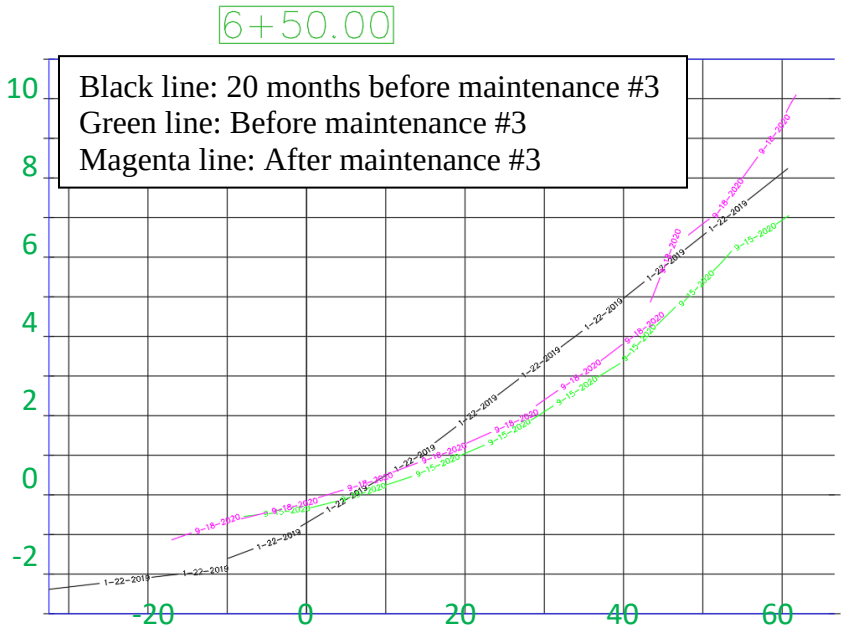


Figure 8-73. Sugar Cove beach profile 6+50 beach maintenance #3

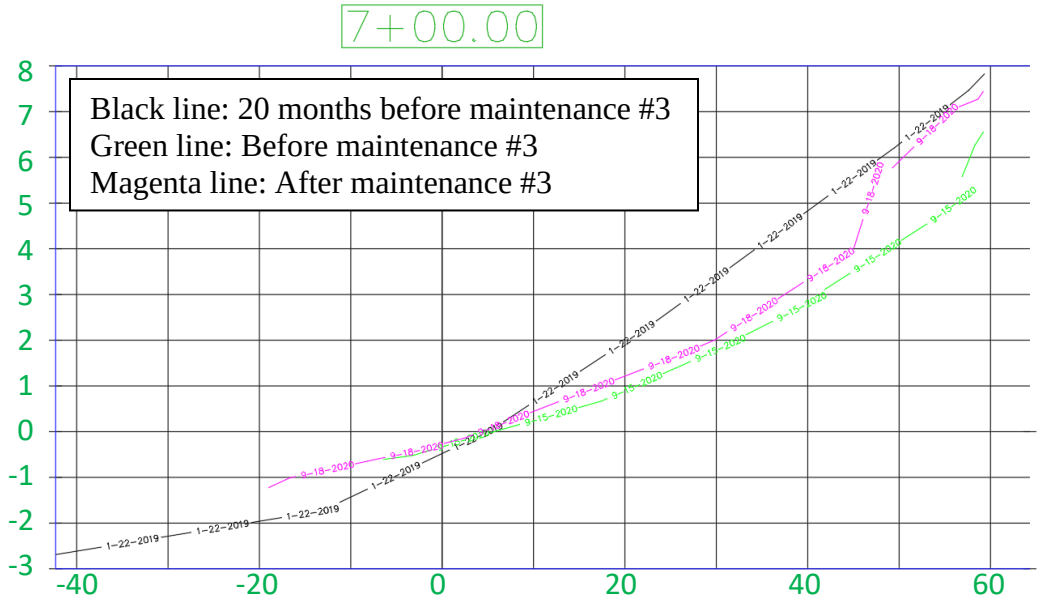


Figure 8-74. Sugar Cove beach profile 7+00 beach maintenance #3

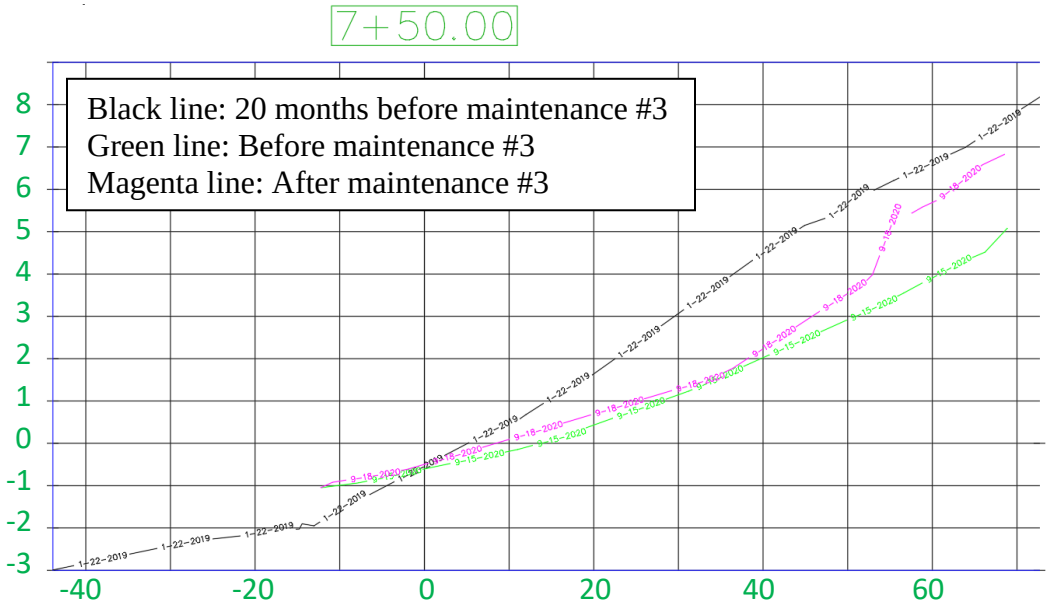


Figure 8-75. Sugar Cove beach profile 7+50 beach maintenance #3

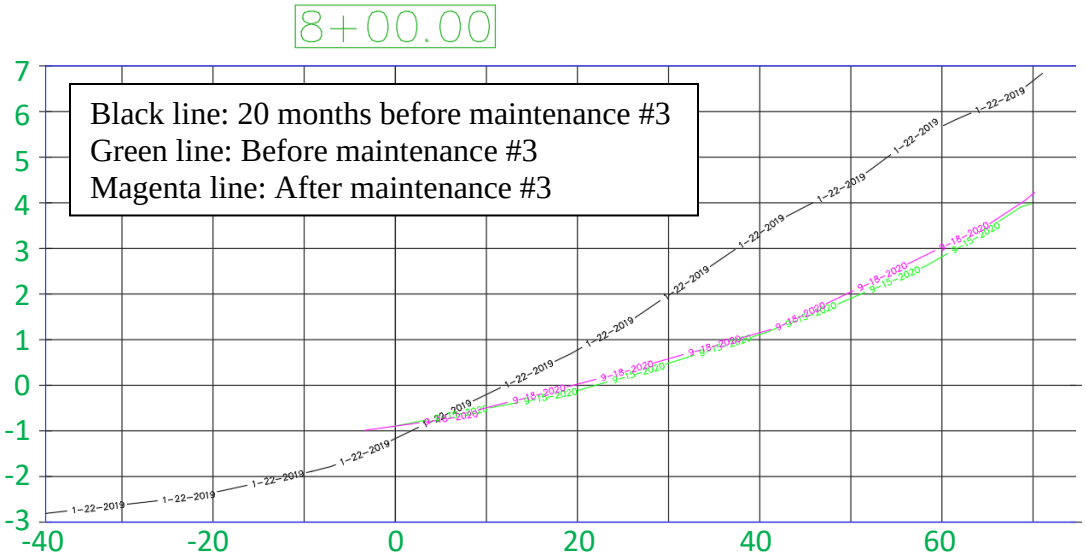


Figure 8-76. Sugar Cove beach profile 8+00 beach maintenance #3

8.7.4 Beach Maintenance # 4 Fall 2021

Data were collected on September 22, 2021 and in the morning on September 28, 2021, prior to sand placement (Figure 8-77), and again on September 29, 2021, immediately following sand placement (Figure 8-78). Representative profiles are presented for station 4 + 00 (Figure 8-80) through station 8 + 00 (Figure 8-88). Station 4 + 00, station 6 + 00, and station 7 + 50 are representative of Transect 7, Transect 5, and Transect 3, respectively. Placement grades are visible in the profile data presented below and represent 1,100 cubic yards of material placed during the maintenance operation.

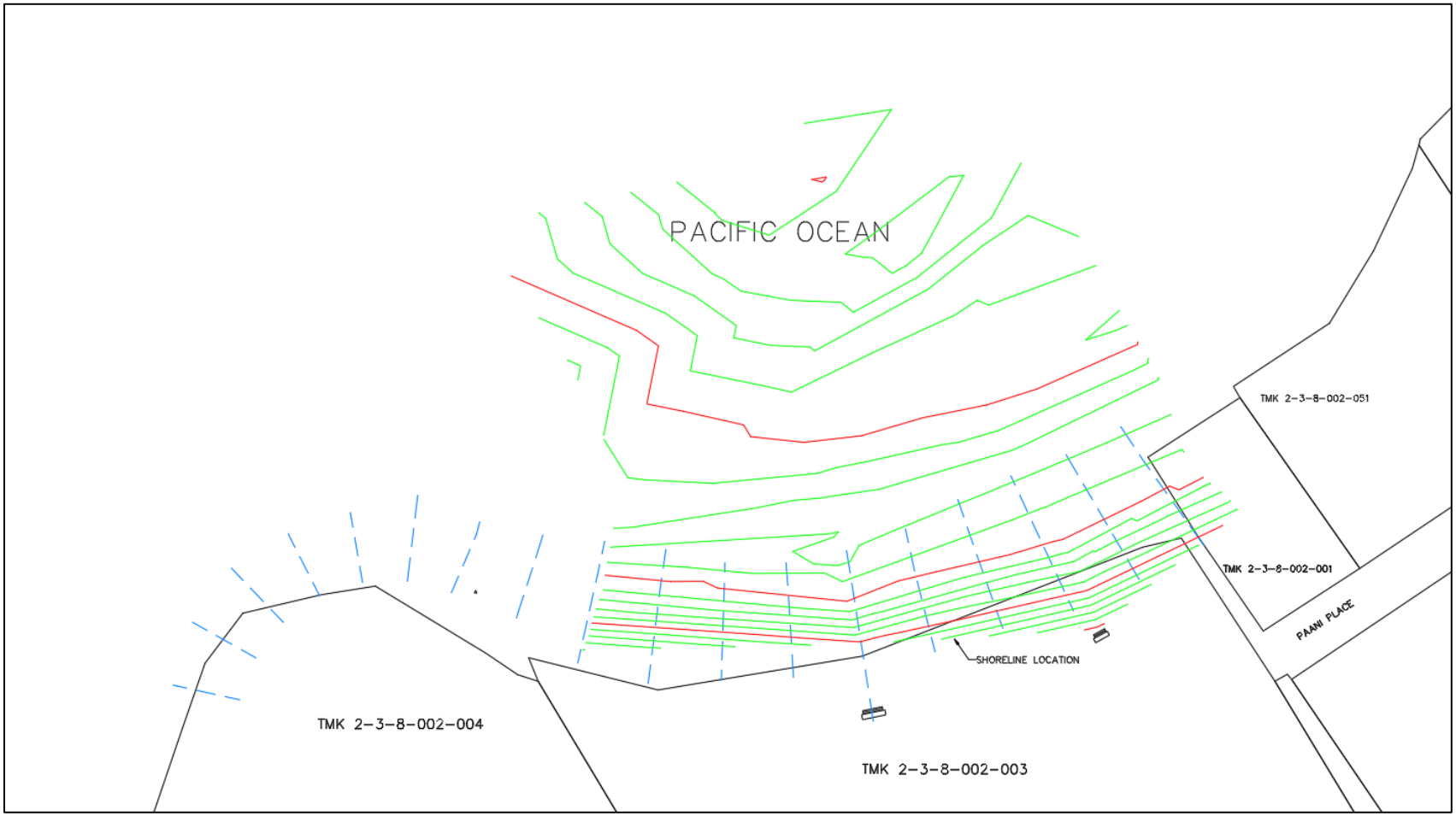


Figure 8-77. Topographic conditions prior to initiating maintenance #4

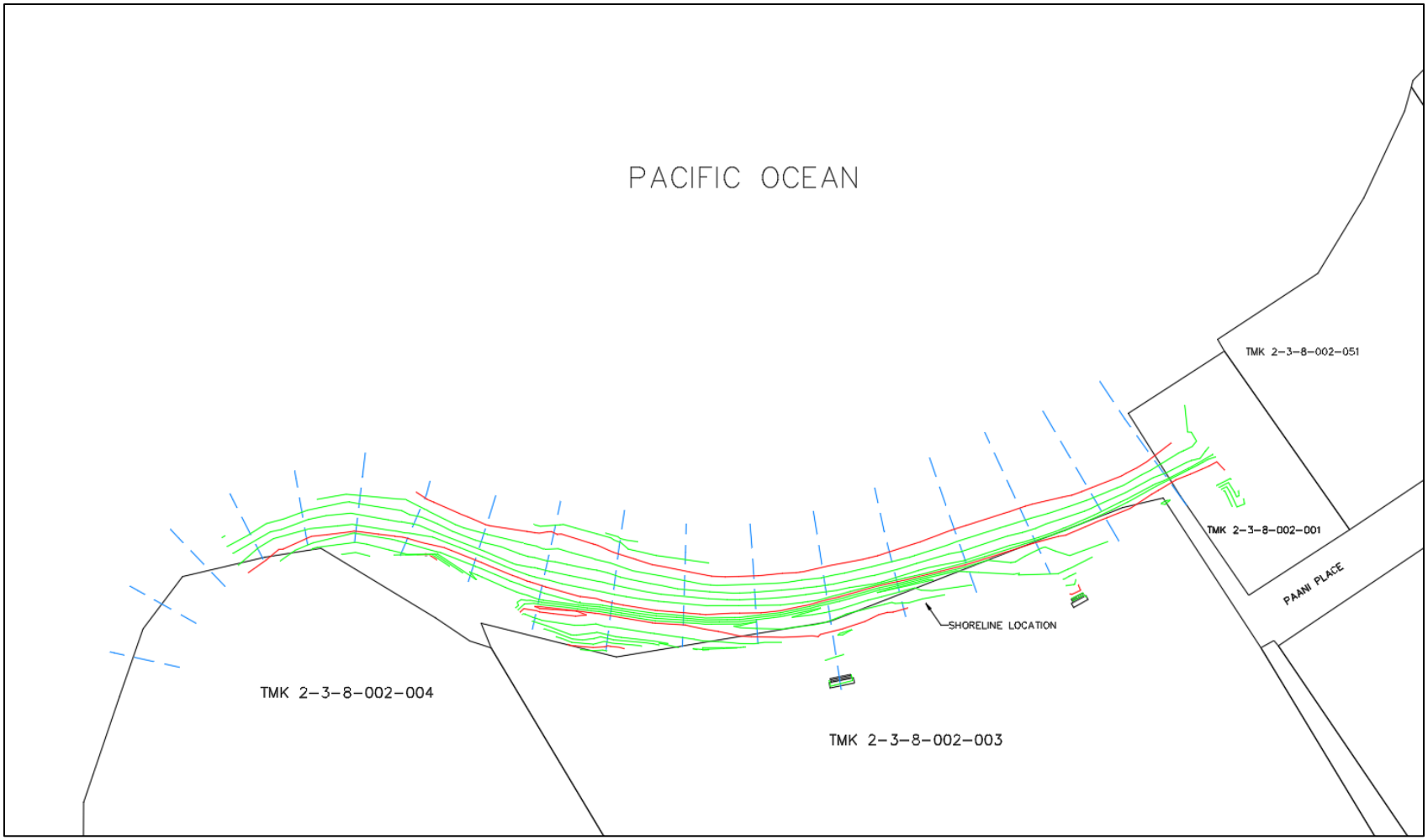


Figure 8-78. September 29, 2021 topographic conditions immediately following maintenance #4

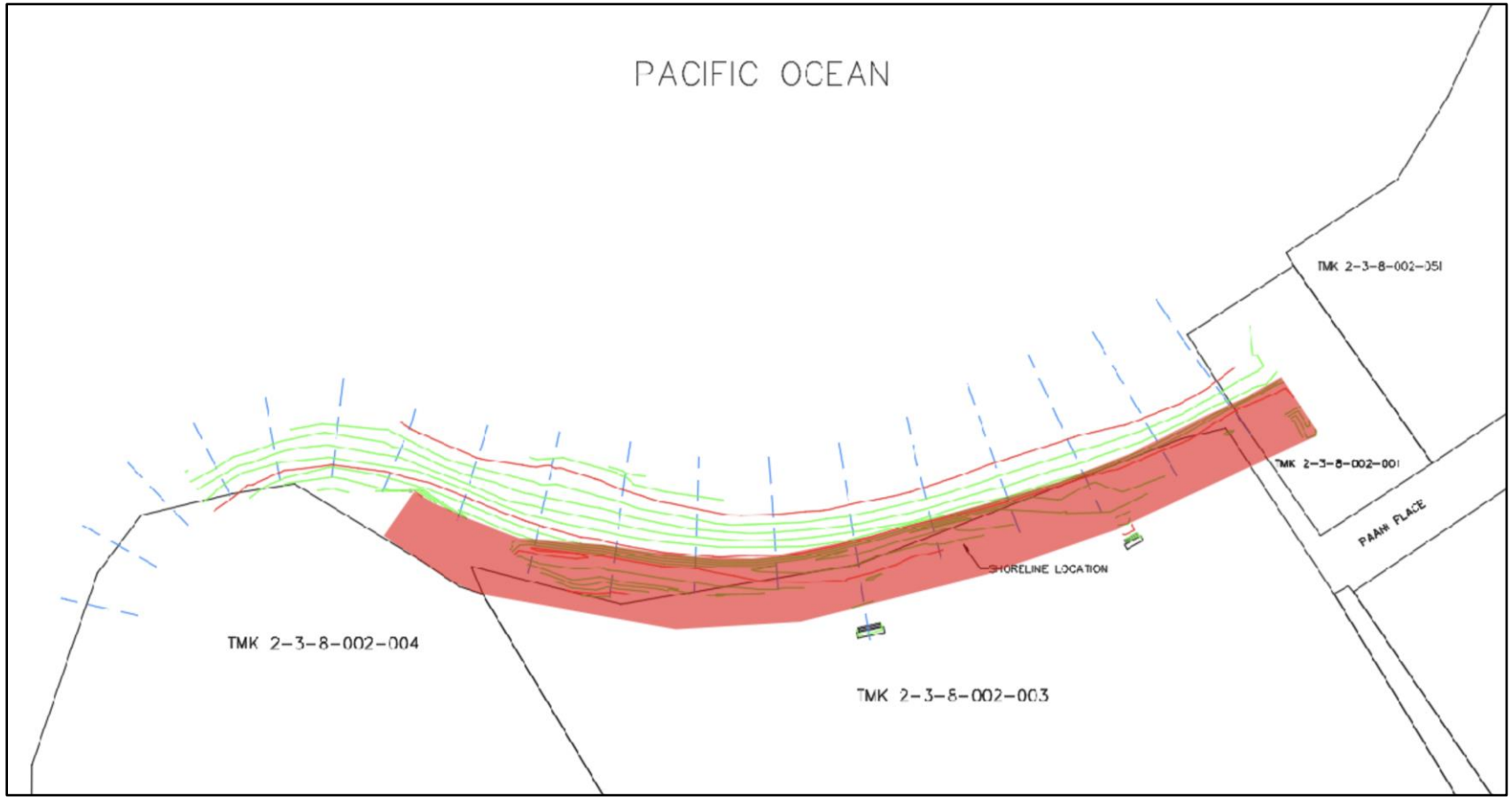


Figure 8-79. Comparison of September 28 and 29, 2021 topographic conditions showing where sand was placed during berm maintenance #4 in red

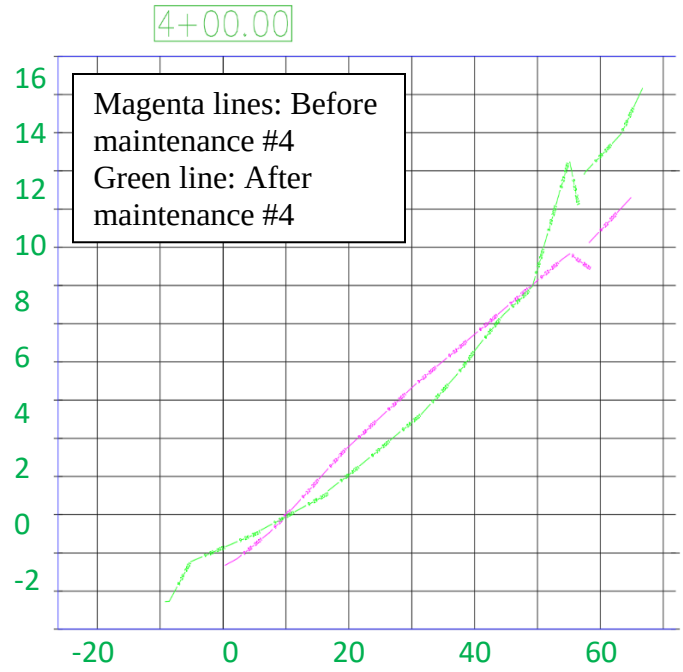


Figure 8-80. Sugar Cove beach profile 4+00 beach maintenance #4

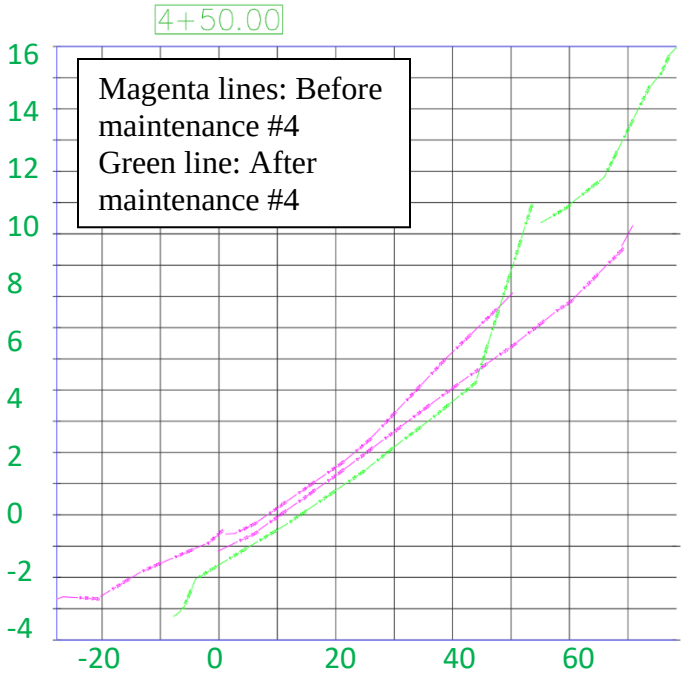


Figure 8-81. Sugar Cove beach profile 4+50 beach maintenance #4

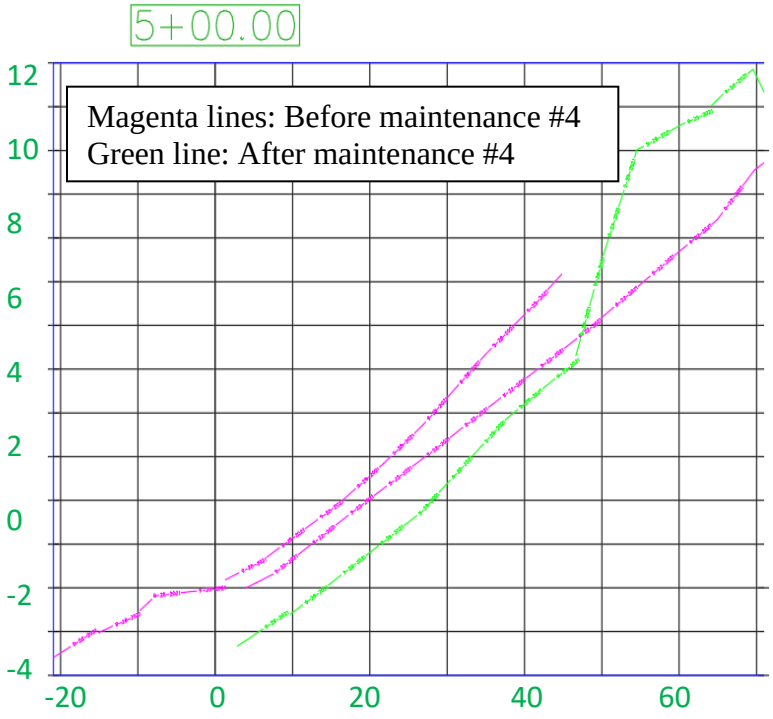


Figure 8-82. Sugar Cove beach profile 5+00 beach maintenance #4

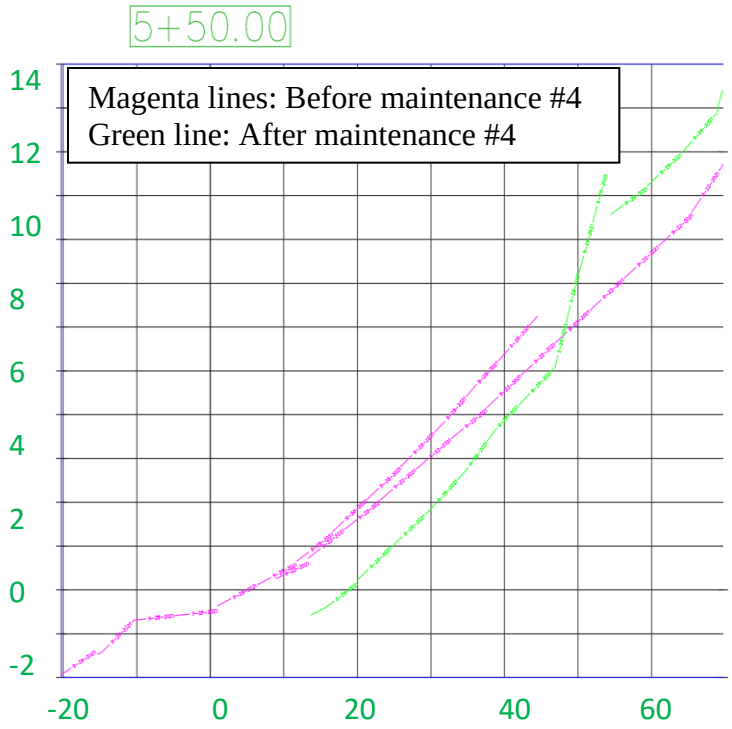


Figure 8-83. Sugar Cove beach profile 5+50 beach maintenance #4

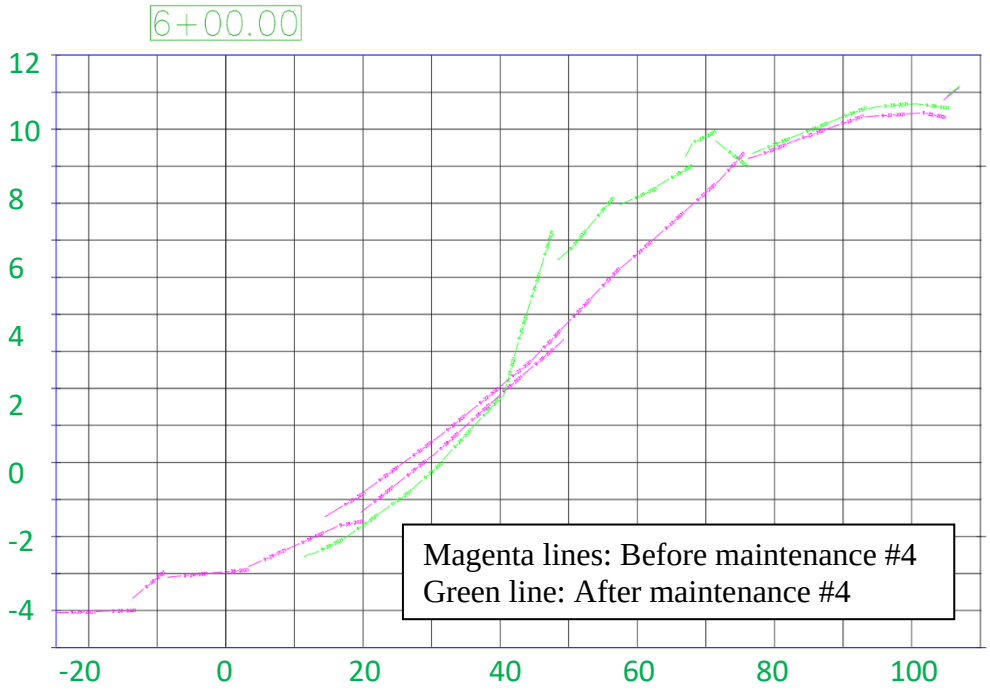


Figure 8-84. Sugar Cove beach profile 6+00 beach maintenance #4

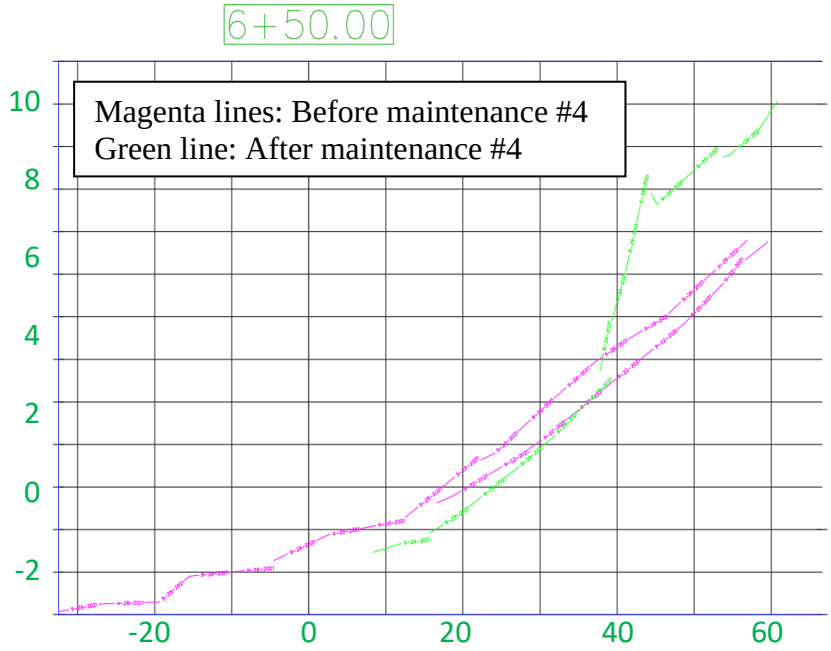


Figure 8-85. Sugar Cove beach profile 6+50 beach maintenance #4

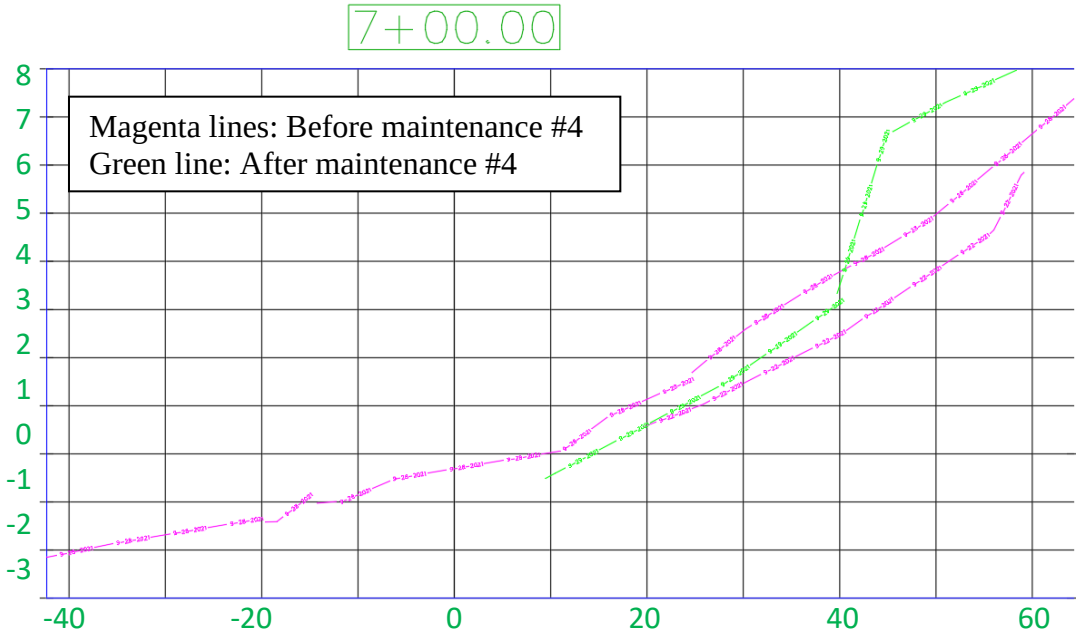


Figure 8-86. Sugar Cove beach profile 7+00 beach maintenance #4

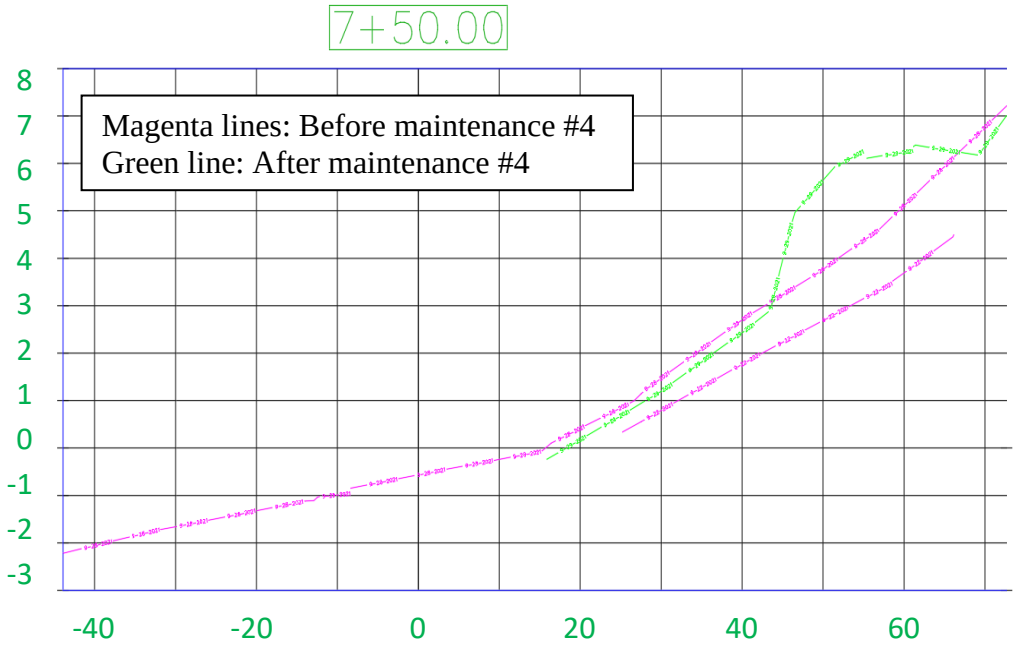


Figure 8-87. Sugar Cove beach profile 7+50 beach maintenance #4

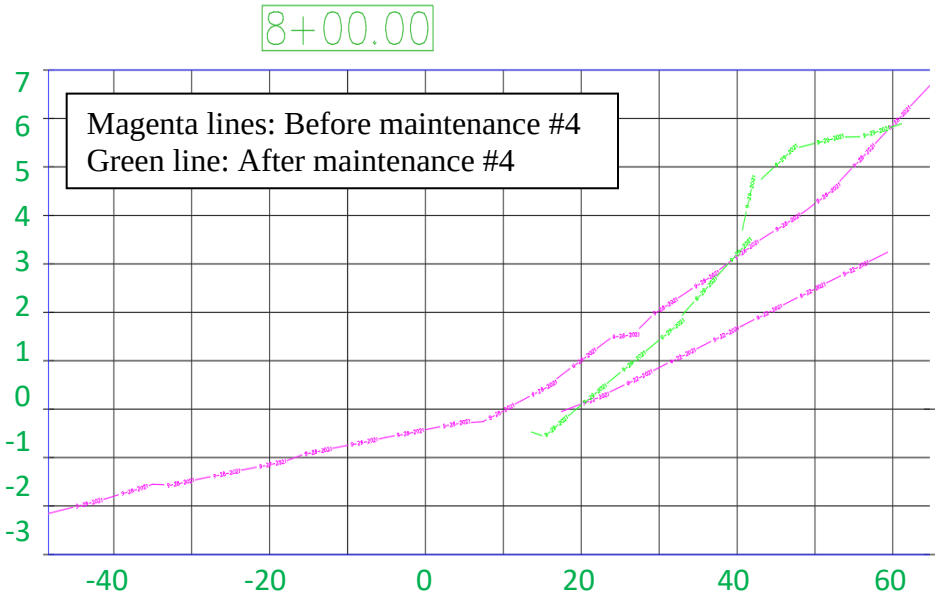


Figure 8-88. Sugar Cove beach profile 8+00 beach maintenance #4

8.7.5 Post Beach Maintenance # 4 Spring 2023

Data were collected on May 11, 2023 (Figure 8-78). Representative profiles are presented for station 4 + 00 (Figure 8-80) through station 8 + 00 (Figure 8-88). Station 4 + 00, station 6 + 00, and station 7 + 50 are representative of Transect 7, Transect 5, and Transect 3, respectively.

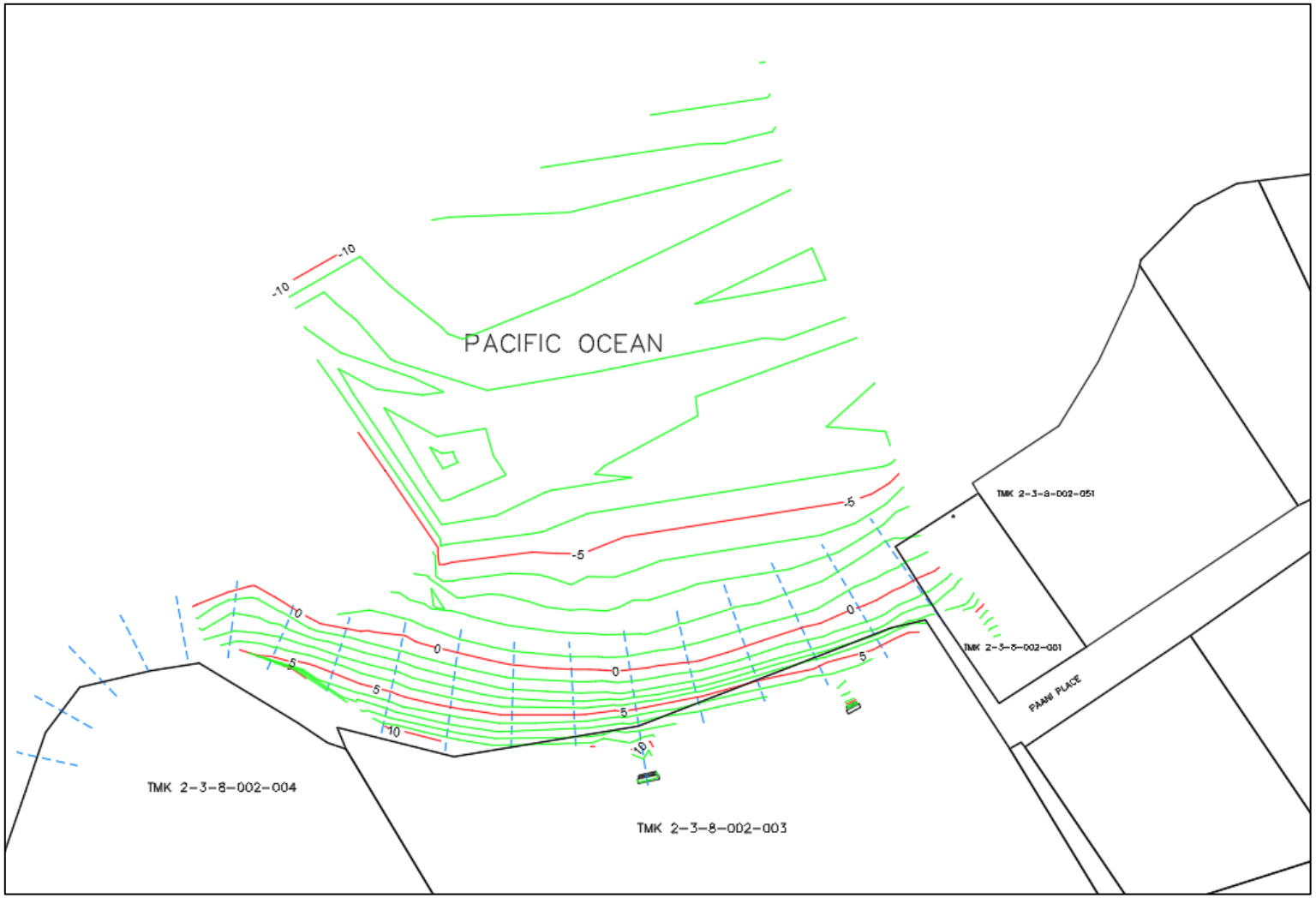


Figure 8-89. May 11, 2023 topo-bathymetric condition of Sugar Cove

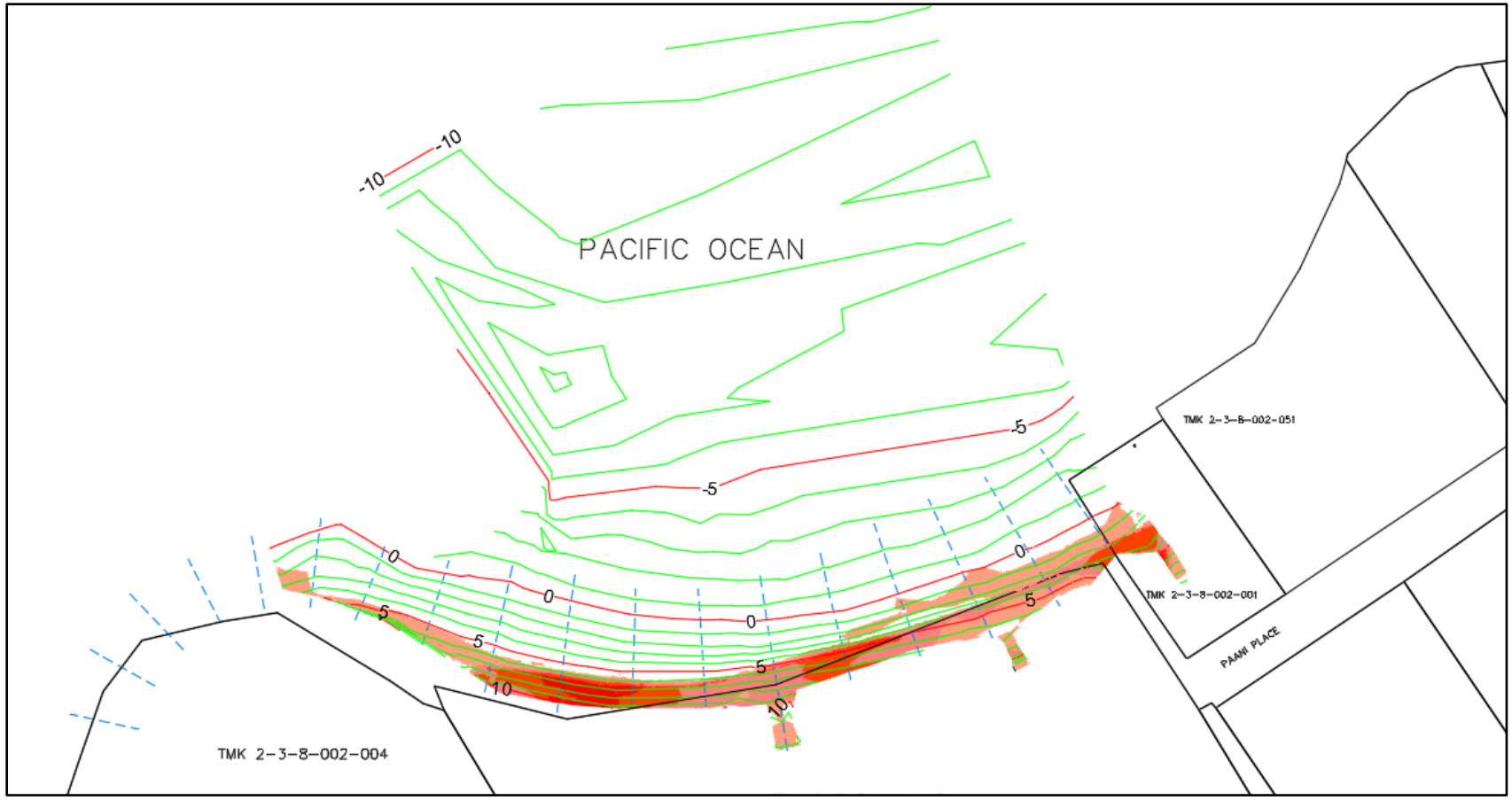


Figure 8-90. May 11, 2023 topo-bathymetric conditions showing sand losses since September 29, 2021 in shades of red

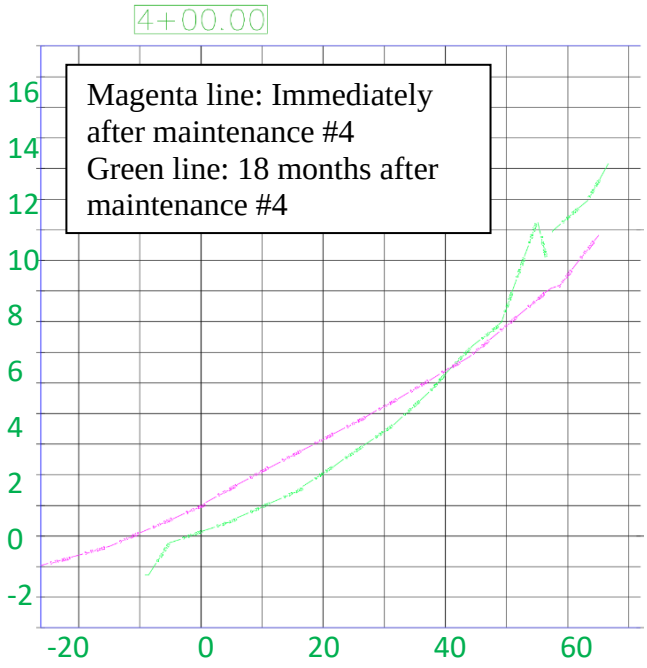


Figure 8-91. Sugar Cove beach profile 4+00 post beach maintenance #4

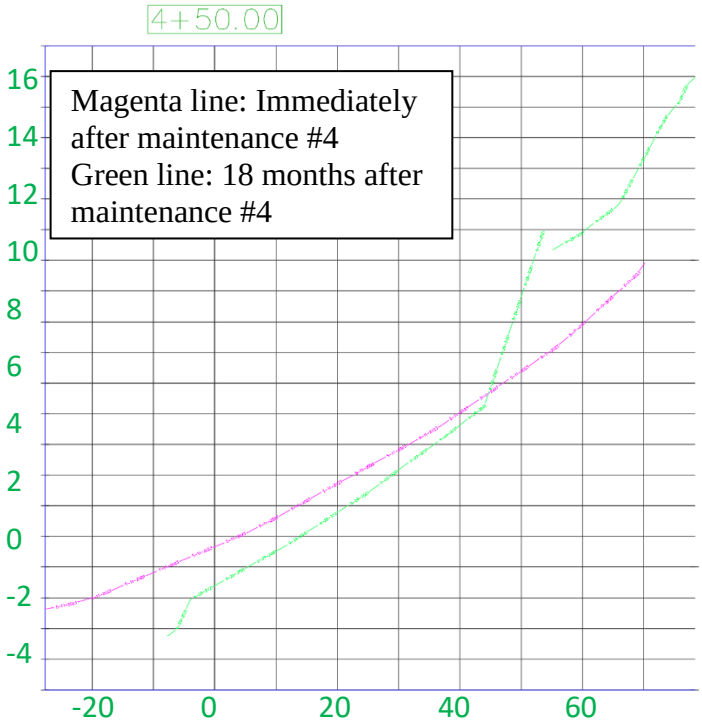


Figure 8-92. Sugar Cove beach profile 4+50 post beach maintenance #4

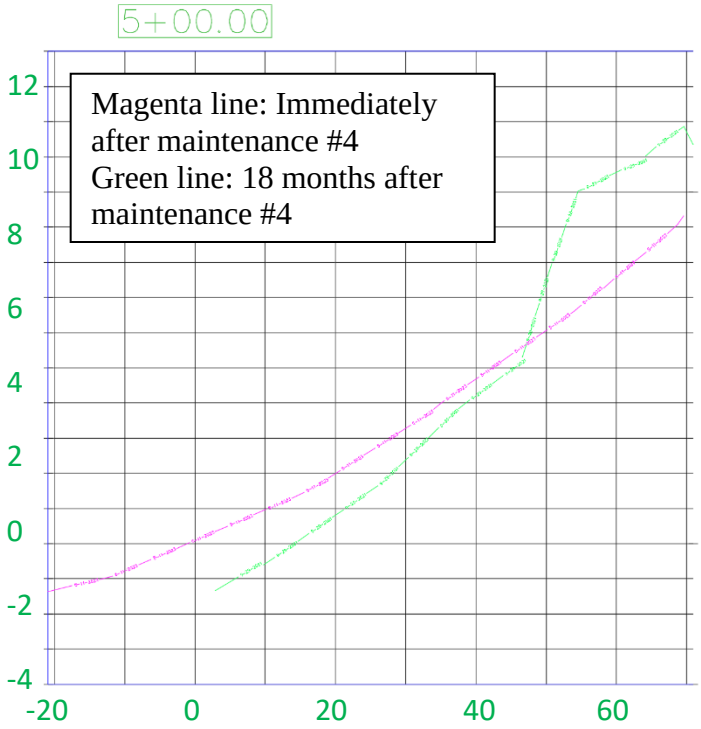


Figure 8-93. Sugar Cove beach profile 5+00 post beach maintenance #4

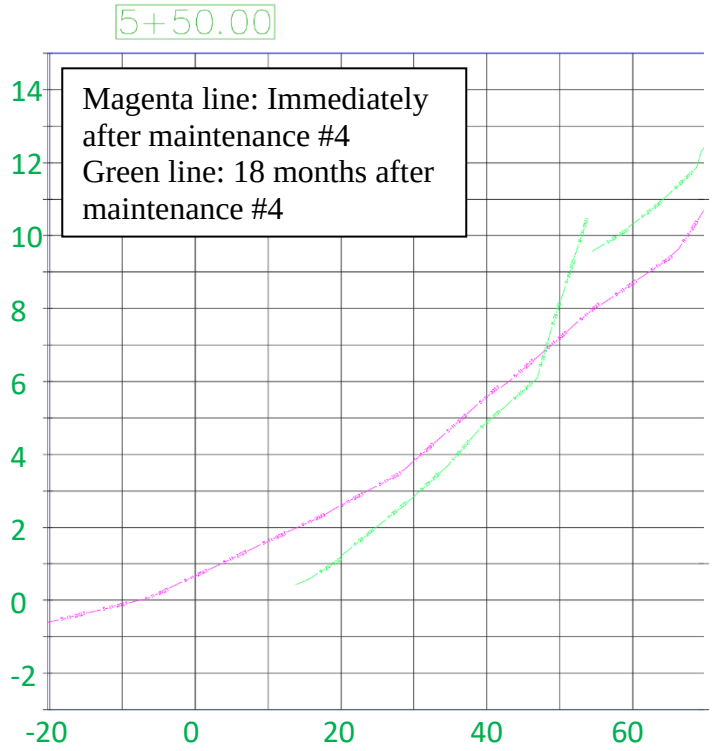


Figure 8-94. Sugar Cove beach profile 5+50 post beach maintenance #4

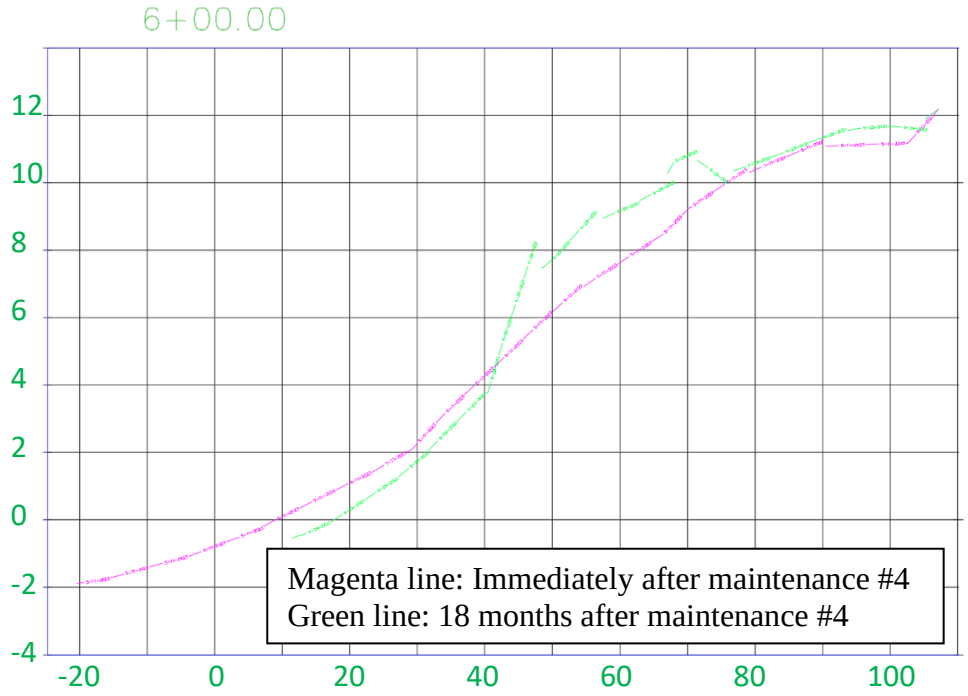


Figure 8-95. Sugar Cove beach profile 6+00 post beach maintenance #4

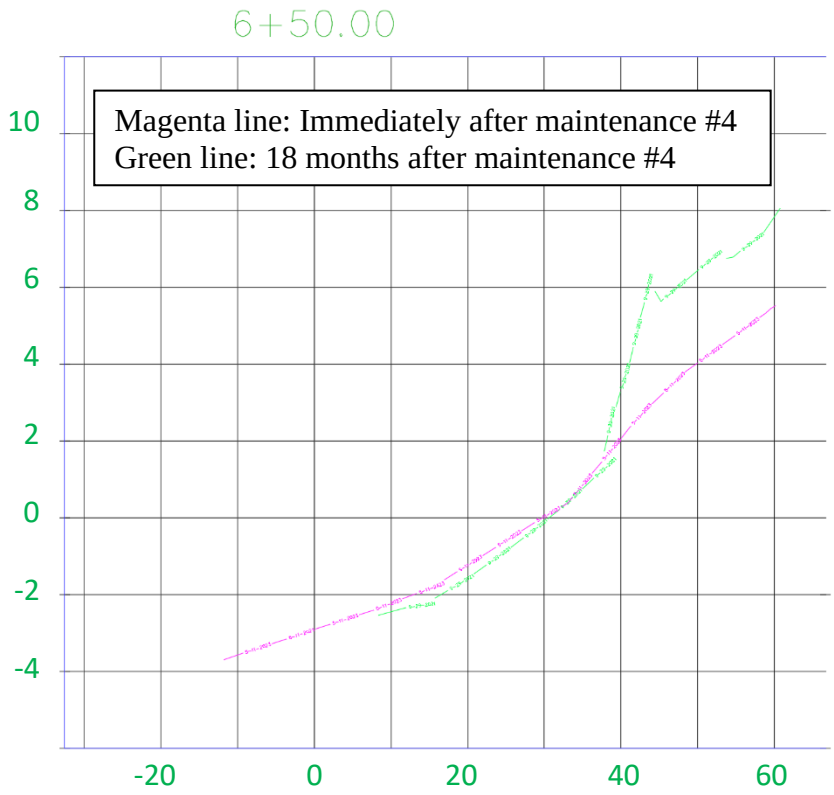


Figure 8-96. Sugar Cove beach profile 6+50 post beach maintenance #4

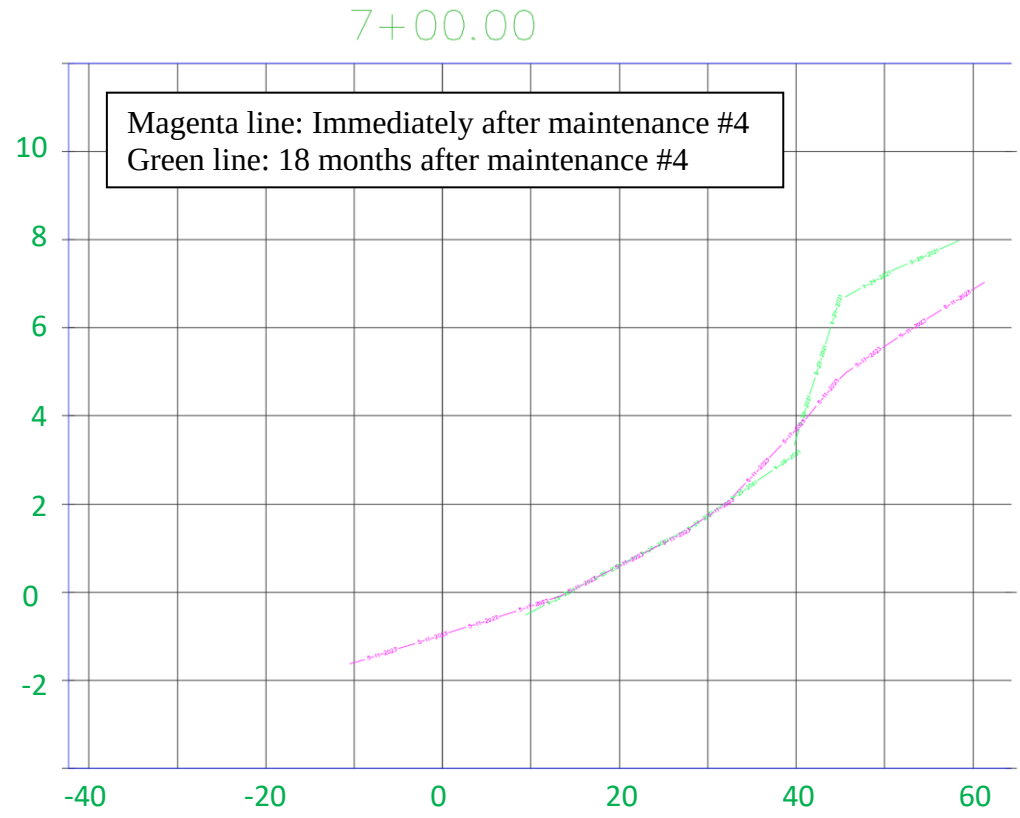


Figure 8-97. Sugar Cove beach profile 7+00 post beach maintenance #4

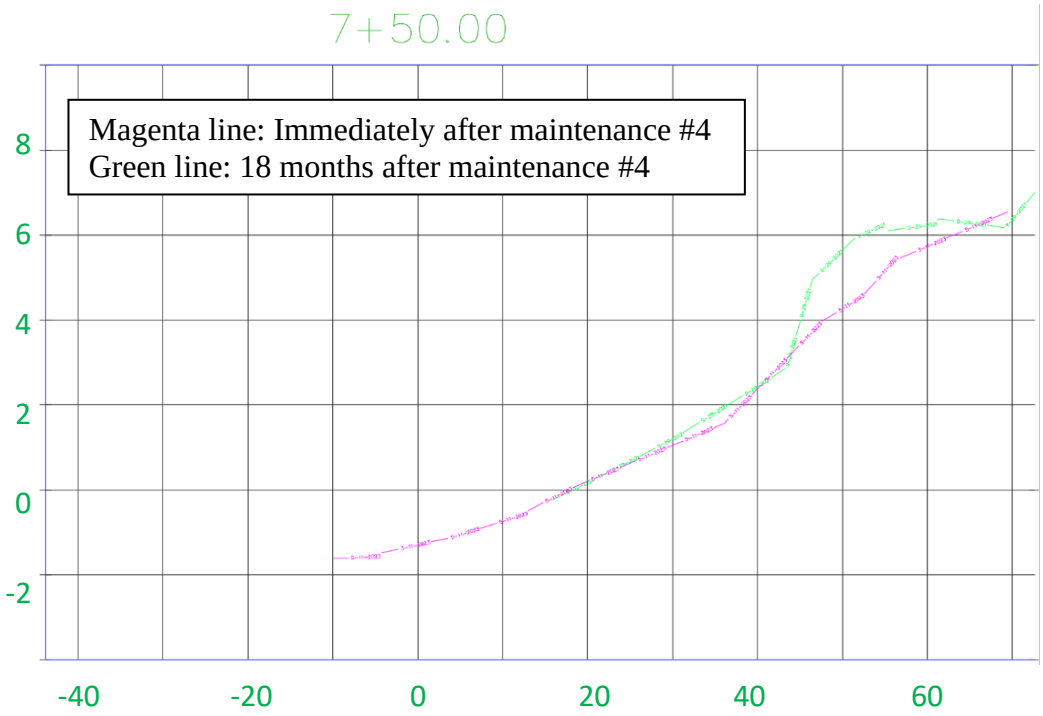


Figure 8-98. Sugar Cove beach profile 7+50 post beach maintenance #4

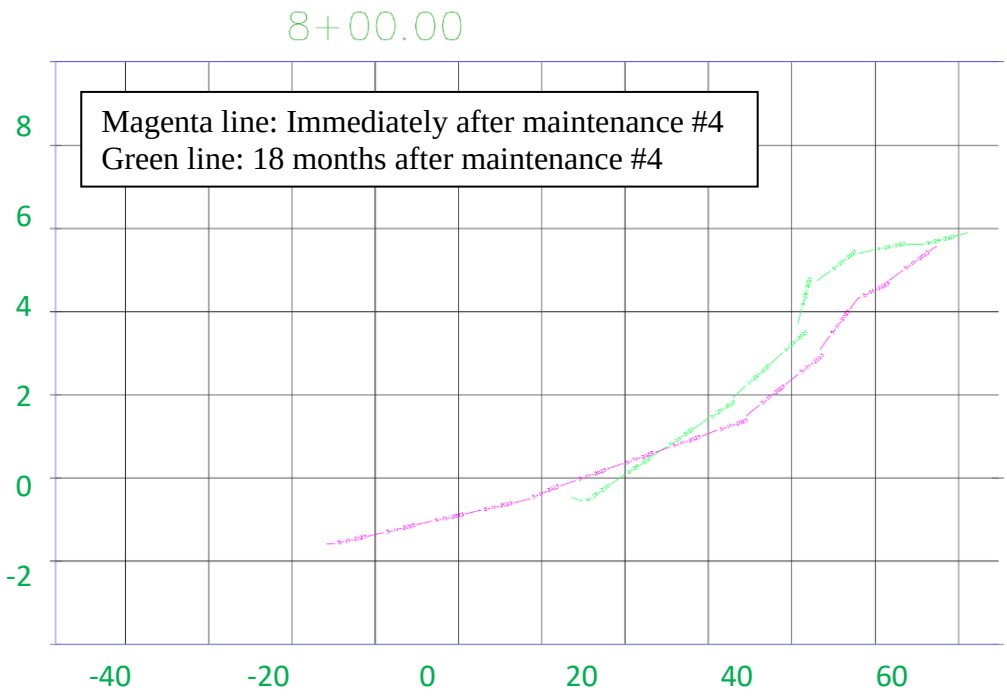


Figure 8-99. Sugar Cove beach profile 8+00 post beach maintenance #4

8.8 Maintenance Activity Lifecycle

Based on more than 20 years of profile and volume records from previous berm and beach maintenance efforts, there was significant evidence indicating that small efforts of roughly 1,000 cy would maintain the berm for approximately 2 years.

The 2015 - 2016 winter El Nino was one of the strongest on record and resulted in very large Pacific swells reaching the Hawaiian shorelines. The 1997-1998 El Nino, previously the strongest El Nino on record, also impacted the shoreline during early beach maintenance efforts. Records show that during and after the 1997 - 1998 El Nino numerous maintenance efforts were required. Between the fall of 1997 and spring of 1999, almost 10,000 cy of sand was placed at the site to keep the beach stable.

The plan acknowledges extreme events, such as tsunami, hurricane, and mesoscale eddy, can severely impact the lifecycle of maintenance efforts at Sugar Cove. Given the severe nature of the 2015 -2016 winter El Nino, a truncated lifecycle for the first maintenance effort was not unexpected. The quick turnaround of maintenance effort #2 allowed the beach to begin to stabilize; however, the consequent sand supply issues resulted in a four-year gap in maintenance efforts. Efforts #3 and #4 have assisted in restoring the minimum sand volume required to stabilize the beach in Sugar Cove, though annual efforts would likely be needed bring the littoral sand volume back to optimum levels.

8.9 Effectiveness of Material Placement

Photo documentation presented in 7.1.2 and 7.2.2 depicts the conditions before and immediately after placement of berm maintenance sand. The only change in conditions on the beach was in the area where sand was placed. The berm in this area was elevated by the placed sand. The berm maintenance efforts restored elevations along the full length of the beach berm and within the County of Maui beach access path (Only Maintenance #1 and #4). Both the berm and the access path were being utilized by members of the public during maintenance and upon completion of placement activities.

9. BEST MANAGEMENT PRACTICES PLAN

The Best Management Practices Plan (BMPP), as approved by both County of Maui and State of Hawaii permits, was utilized to ensure that adequate protective measures are in place during regular beach maintenance of Sugar Cove, Sprecklesville, Maui, Hawaii. This plan was designed to prevent, if possible, or minimize adverse impacts to the environment. The project specifications required the Construction Contractor to adhere to environmental protection measures, including, but not limited to, those included in this plan.

9.1 General

This section covers the requirements of environmental and pollution control during construction activities. The Contractor shall be responsible for conformance to all appropriate State of Hawaii Statutes.

1. With the exception of those measures set forth elsewhere in this plan, environmental protection shall consist of the prevention of environmental pollution as the result of construction operations under this project. For the purpose of this plan, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare, unfavorably alter ecological balances of importance to human life, affect other species of importance to man, or degrade the utilization of the environment for aesthetic and recreational purposes. This includes Water Pollution, as defined by Hawaii Revised Statute Title 19, Chapter 342D.1.

2. The work shall include the following:

    A. Make sure that all permits required for this plan are obtained and valid for the construction period.

    B. Provide all facilities, equipment and structural controls for minimizing adverse impacts upon the environment during the construction period.

3. Applicable Regulations: In order to provide for abatement and control of environmental pollution arising from the construction activities of the Contractor and his subcontractors in the performance of the work performed shall comply with the intent of the applicable Federal. State, and local laws and regulations concerning environmental pollution control and abatement, including, but not limited to the following regulations:

    A. State of Hawaii, Department of Health, Administrative Rules. Chapter 55. WATER POLLUTION CONTROL: Chapter 54, WATER QUALITY STANDARDS.

    B. State of Hawaii, Department of Health, Administrative Rules, Chapter 59, AMBIENT AIR QUALITY: Chapter 60, AIR POLLUTION CONTROL LAW.

    C. State of Hawaii, Department of Health, Administrative Rules, Chapter 44A, VEHICULAR NOISE CONTROL.

D. State of Hawaii, Occupational Safety and Health Standards, Title 12, Department of Labor and Industrial Relations, Subtitle 8, Division of Occupational Safety and Health, Subparagraph 12-202-13, ASBESTOS DUST: Environmental Protection Agency, Code of Federal Regulations Title 40, Part 61 Subpart A, NATIONAL EMISSION STANDARDS FOR AIR POLLUTANTS and Subpart B, NATIONAL EMISSION STANDARDS FOR ASBESTOS; and U.S. Department of Labor Occupational Safety and Health Administration (OSHA) Asbestos Regulations, Code of Federal Regulations Title 29, Part 1910.

9.2 Material Management

1. All maintenance equipment and material shall be free of contaminants of any kind including: excessive silt, sludge, anoxic or decaying organic matter, clay, dirt, oil, floating debris, grease or foam or any other pollutant that would produce an undesirable condition to the beach or water quality.

2. All berm fill sand shall be free from any objectionable sludge, oil, grease, scum, excessive silt, organic material, or other floating material.

9.3 Waste Management

Note: No hazardous wastes are anticipated for this project.

1. Any maintenance activity related debris that may pose an entanglement hazard to marine protected species must be removed from the project site if not actively being used and/or at the conclusion of the maintenance activity.

2. The Contractor shall not dispose of any concrete, steel, wood, and any other debris into lagoon waters. Any debris that falls into the water shall be removed at the Contractor's own expense.

3. No contamination (trash or debris disposal, alien species introductions, etc.) of marine (reef flats, lagoons, open oceans, etc.) environments adjacent to the project site shall result from project related activities.

4. The Contractor shall remove all floating or submerged materials and/or debris at the end of each day, with the exception of any silt containment devices, as needed.

5. The Contractor shall ensure that an Emergency Spill Response Plan is in place which shall detail procedures for managing the accidental release of petroleum products to the aquatic environment during construction. Absorbent pads, containment booms, and skimmers will be available to facilitate the cleanup of petroleum spills.

6. Any spills or other contaminations shall be immediately reported to the DOH Clean Water Branch (808-586-4309).

7. In the event that floating hydrocarbon (oil, gas) products are observed, the Contractor or his designated individual will be responsible for directing that in-water work be halted so that appropriate corrective measures are taken in accordance with the Oil Spill Response Plan. The Department of Land and Natural Resources shall be notified as soon as practicable, and the activity causing the plume will be modified by containment. The responsible individual will document the event and the measures taken to correct the issue and will report the incident (with photographs) to the Office of Conservation and Coastal Lands as soon as is practicable. Work may continue only after the issue is no longer visible.

8. No contamination of the marine environment shall result from the permitted activities. Particular care must be taken to ensure that no petroleum products, trash, or other debris enter near-shore and open ocean waters. When such material is found within the project area, the Contractor, or his designated construction agent, shall collect, and dispose of this material at an approved upland disposal site.

9. Waste materials and waste waters directly derived from maintenance activities shall not be allowed to leak, leach, or otherwise enter marine waters.

10. Construction operations shall be conducted so as to prevent the discharge or accidental spillage of pollutants, solid waste, debris, and other objectionable wastes in surface waters and underground water sources.

9.4 Vehicle and Equipment Management

1. Fueling operations will be monitored to prevent spills, leaks, and overflows. Equipment will be fueled away from any drain or shoreline. A spill pan will be used to catch spill/leaks. Equipment will not be "topped off." Spill cleanup materials will be readily accessible.

2. Construction equipment (except small tools, generators, welders, etc.) shall be maintained off-site. If emergency repairs or maintenance on large equipment must be performed, drip pans or drop cloth will be placed under the vehicle or equipment to catch any spills/leaks.

3. Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. Manage all used oil generated on site in accordance with 40 CFR 279. Determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. Used oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste.

4. Wherever trucks and/or vehicles leave the site and enter surrounding paved streets, the Contractor shall prevent any material from being carried onto the pavement. Wastewater shall not be discharged into existing streams, waterways, or drainage systems such as gutters and catch basin unless treated to comply with the State Department of Health water pollution regulations.

9.5 Historic or Cultural Features

1. No adverse impacts to any historical or cultural feature are expected, since the project is located on beach fill material, made of processed and well-sorted carbonate sediment, sitting atop the seawall.

2. Should any unanticipated archaeological site(s), such as walls, platforms, pavements and mounds, or remains such as artifacts, burials, concentrations of charcoal or shells be uncovered by the work activity, all work shall cease in the immediate area and the contractor shall notify the State Historic Preservation Office at 808.692.8015. No work shall resume until the owner/contractor obtains clearance from the Historic Preservation Office.

9.6 Environmental Protection

1. All permits and clearances shall be obtained prior to the start of any maintenance activities. The Contractor and his sub-contractors shall ensure that all construction work complies with all permit conditions and commitments made with environmental agencies.

2. Any project related debris that may pose an entanglement hazard to protected species must be removed from the project site if not actively being used and/or at the conclusion of the proposed project.

3. All project activities shall be confined to areas defined by the drawings and specifications. No project materials shall be stockpiled in the marine environment outside of the immediate project area.

4. Visual inspections will be documented with photographs and written descriptions, if necessary.

5. The Contractor shall perform the work in a manner that minimizes environmental pollution and damage as a result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of the maintenance activities.

6. The contractor shall complete daily inspection of equipment for conditions that could cause spills or leaks; clean equipment prior to operation near the water; properly site storage, refueling, and servicing sites; and implement spill response procedures and stormy weather preparation plans.

7. The project shall be completed in accordance with all applicable State and County health and safety regulations.

8. The Contractor shall provide notifications to the National Marine Fisheries Services, efhesaconsult@noaa.gov, at least 72 hours prior to the scheduled start of berm maintenance

activities. The notification shall include the associated permit numbers, a project description, and who the client is.

9. Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified. Conform to the national permitting requirements of the Clean Water Act.

10. Do not intentionally disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

11. Provide and maintain, during the life of the contract, environmental protection measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

9.7 Protected Species

1. The project manager shall designate a competent observer to survey the marine areas adjacent to the proposed action for ESA-listed marine species, including but not limited to the green sea turtle, hawksbill sea turtle, and Hawaiian monk seal.

2. Constant vigilance shall be kept for the presence of Federally Listed Species.

3. Visual surveys for ESA-listed species shall be made prior to the start of work each day, and prior to resumption of work following any break of more than one-half hour, to ensure that no protected species are in the area (typically within 50 yards of the proposed work).

4. Work shall be postponed or halted when ESA-listed species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed after work has already begun, that work may continue only if there is no way for the activity to adversely affect the animal(s). For example, divers performing surveys or underwater work (excluding the use of toxic chemicals) is likely safe. The use of heavy machinery is not.

5. Do not attempt to feed, touch, ride, or otherwise intentionally interact with any ESA listed species.

6. All on-site project personnel must be apprised of the status of any listed species potentially present in the project area and the protections afforded to those species under federal laws. A handbook explaining the laws and guidelines for listed species in Hawaii may be downloaded from:

http://www.fpir.noaa.gov/Library/PRD/Laws%20and%20Policies/HawaiiOceanUsersGuide_2004.pdf

7. The Contractor shall keep a record of all protected species sightings, incidents of disturbance, or injury, and shall provide a report to the State and the National Marine Fisheries Service (NMFS), and will be the contact person for any issues involving green sea turtles during berm maintenance activities.

8. Upon sighting of a monk seal or turtle within the safety zone during project activity, immediately halt the activity until the animal has left the zone. In the event that a marine protected species enters the safety zone and the project activity cannot be halted, conduct observations and immediately contact NMFS staff in Honolulu to facilitate agency assessment of collected data. For monk seals contact the Marine Mammal Response Coordinator, David Schofield, at 808-944-2269, as well as the monk seal hotline at 1-888-256-9840. For turtles, contact the turtle hotline at 808-983-5730.

9. The Contractor shall immediately report any incidental take of marine mammals. The incident must be reported immediately to NOAA Fisheries' 24-hour hotline at 1-888-256-9840, and the Regulatory Branch of the USACE at 808-438-9258. In Hawaii, any injuries incidents of disturbance or injury to sea turtles must be immediately reported and must include the name and phone number of a point of contact, the location of the incident, and the nature of the take and/or injury. The incident should also be reported to the Pacific Island Protected Species Program Manager, Southwest Region (Tel: 808-973-2987, fax: 808-973-2941).

10. Before any equipment, anchors(s), or material enters the water, a responsible party shall verify that no ESA-listed species are in the area where the equipment, anchor(s), or materials are expected to contact the substrate. If practicable, the use of divers to visually confirm that the area is clear is preferred.

11. For any equipment used in undertaking the authorized work, the 160 dB and 120 dB isopleths shall not exceed the 50-yard shut-down range for impulsive and continuous sounds sources, respectively.

12. Unless specifically covered by a separate permit that allows activity in proximity to protected species, all in-water work will be postponed when whales are within 100 yards or other protected species are within 50 yards. Activity will commence only after the animal(s) depart the area.

9.8 Oil and Spill Containment

1. The Contractor shall ensure that the Emergency Spill Response Plan, detailed in this document, is in place which shall detail procedures for managing the accidental release of petroleum products to the aquatic environment during construction. Fueling of project related

vehicles and equipment should take place away from the water. Absorbent pads, containment booms, and skimmers will be stored on site to facilitate the cleanup of petroleum spills.

2. Any spills or other contaminations shall be immediately reported to the DOH Clean Water Branch (808-586-4309) and through email: cleanwaterbranch@doh.hawaii.gov.

3. Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. In accordance with 40 CFR 112, surround all temporary fuel oil or petroleum storage tanks with temporary berms or containment of sufficient size and strength to contain the contents of the tanks, plus 10 percent freeboard for precipitation. The berm will be impervious to oil for 2 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs.

4. Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated by environmental law. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release.

5. Maintain spill cleanup equipment and materials at the work site. Clean up all hazardous and non-hazardous waste spills.

9.9 Erosion Control

1. Silt curtains and/or booms will be individually anchored and regularly inspected during sand placement operations, as needed.

2. Silt curtains and/or booms will be left in place each night, as needed. All anchors and booms will be inspected prior to sunset.

3. The Contractor is responsible for the proper handling, storage and/or disposal of all waste generated by maintenance activities.

4. The Contractor shall confine all maintenance activities to areas defined by the drawings and specifications. No materials shall be stockpiled in the marine environment.

5. The Contractor shall keep maintenance activities under surveillance, management, and control to avoid pollution of surface or marine waters. Daily visual inspection of the project site and its environs will be conducted by a designated individual, or his representative, to verify that the permitted activities do not result in uncontrolled adverse environmental impacts.

6. Visual inspections will include monitoring of the effectiveness of the silt curtains and/or booms to ensure proper function.

7. Visual inspections will be documented with photographs and written descriptions, if necessary.

8. Sand fill placement shall not be done during storms or periods of high surf.

9. Visual monitoring will include ongoing inspections for turbidity outside of the confines of the silt curtains and/or booms. In the event that turbidity is observed outside of the silt curtains, work shall stop, and the silt curtains shall remain in place until the turbidity dissipates. Silt curtains, booms, and anchors shall be inspected after dissipation and prior to returning to sand retrieval operations.

10. Drainage outlets shall be maintained to minimize erosion and pollution of the waterways during construction. Surface runoff shall be controlled in order to minimize silt and other contaminants entering the water. Should excessive siltation or turbidity result from the Contractor's method of operation, the Contractor shall install silt curtains or other silt contaminant devices as required to correct the problem. Such corrective measures shall be at no additional cost to the Owner.

11. Wherever trucks and/or vehicles leave the site and enter surrounding paved streets, the Contractor shall prevent any material from being carried onto the pavement. Wastewater shall not be discharged into existing streams, waterways, or drainage systems such as gutters and catch basin unless treated to comply with the State Department of Health water pollution regulations.

12. During interim grading operations, the grade shall be maintained so as to preclude any damage to adjoining property from water and eroding soil.

13. Temporary berms, cut-off ditches and other provisions which may be required because of the Contractor's method of operations shall be installed at no cost to the Owner.

14. Drainage outlets and silting basins shall be constructed and maintained as directed by the Owner to minimize erosion and pollution of waterways during construction.

15. Mean higher high water will be marked along the shoreline prior to conducting operations to ensure that neither equipment nor fill operate or are placed seaward of MHHW.

16. Operational bounds on land will be marked with traffic cones and patrolled by project staff as needed to ensure that members of the public do not enter the project area.

9.10 Noise Control

1. Best management practices shall be utilized to minimize adverse effects to air quality and noise levels, including the use of emission control devices and noise attenuating devices.

2. Noise shall be kept within acceptable levels at all times in conformance with HAR Title 11 § 46 Community Noise Control, State Department of Health, Public Health Regulations. The

contractor shall obtain and pay for a community noise permit from the State Department of Health when equipment or other devices emit noise at levels exceeding the allowable limits.

3. Construction equipment shall be equipped with suitable mufflers to maintain noise within levels complying with applicable regulations.

4. Starting of equipment meeting allowable noise limits shall not be done prior to 7:00 a.m. without prior approval. Equipment exceeding allowable noise limits shall not be started up prior to 7:30 a.m. Equipment meeting allowable noise limits shall not be done after 10:00 p.m. without prior approval.

5. Make the maximum use of low-noise-emission products, as certified by the EPA.

9.11 Dust Control

1. Dust, which could damage crops, orchards, cultivated fields, and dwellings, or cause nuisance to persons, shall be abated and control measures shall be performed. The Contractor shall be held liable for any damage resulting from dust originating from his operations.

2. The Contractor, for the duration of the contract, shall maintain all excavations, embankments, haul roads, permanent access roads, plant sites, waste disposal areas, borrow areas, and all other work areas within or without the project limits free from dust which would cause a hazard to the work, or the operations of other contractors, or to persons or property. Industry accepted methods of stabilization suitable for the area involved, such as sprinkling or similar methods will be permitted. Chemicals or oil treating shall not be used.

3. The Contractor shall prevent dust from becoming airborne at all times including non-working hours, weekends, and holidays in conformance with the State Department of Health, Administrative Rules, Title 11, Chapter 60 - Air Pollution Control.

4. The method of dust control and costs shall be the responsibility of the Contractor.

5. The Contractor shall be responsible for all dust damage claims arising from his work.

9.12 Air Pollution Control

1. Emission: The Contractor shall not be allowed to operate equipment and vehicles that show excessive emissions of exhaust gases until corrective repairs or adjustments are made to the satisfaction of the Owner.

9.13 Operational Controls

1. This plan will be reviewed with the project field staff prior to the start of work.

2. All activities significantly impacting the environment will not begin until appropriate BMP's are properly installed.

3. Construction will be immediately stopped, reduced or modified; and/or new or revised BMP's will be immediately implemented as needed to stop or prevent polluted discharges to receiving waters. New or revised BMP's will be approved by appropriate regulatory agencies prior to re-commencing work.

4. The Contractor is responsible for all regulatory notification requirements in accordance with Federal, State and local regulations. Submit copies of all regulatory notifications to the Contracting Officer prior to the commencement of work activities.

5. The Contractor is responsible for meeting all permit requirements and including how they will be addressed in the work plans. The Contractor will provide the personnel, materials, and equipment necessary to meet the permit requirements for the project.

9.14 Structure, Authority, and Responsibility

1. The Project Manager/Superintendent/Project Engineer will ensure compliance with this plan.

2. The Project Manager/Superintendent/Project Engineer will appoint and train one (1) additional individual to properly install all BMP's and to comply with all aspects of this plan.

3. The Property Owner(s) is also responsible for compliance to the BMPP.

9.15 Training

1. Employees will be instructed in the proper installation of the BMPP materials.

2. BMP's will be covered in a toolbox safety meeting.

3. BMP's will be discussed, as applicable, for each new phase of work.

9.16 Health and Safety Plan

1. Operational bounds on land will be marked with traffic cones or caution tape and patrolled by project staff as needed to ensure that members of the public do not enter the project area.

2. Signs will be posted to warn and educate the public about berm maintenance activities.

3. Project implementation will not interfere with the public's right to reasonable navigation.

9.17 Inspection and Monitoring

1. The Project Manager/Superintendent/Project Engineer or the assigned trained individual will conduct a visual inspection of all BMPP's daily.

2. All minor repairs and maintenance of the BMP's will be completed within 48 hours of detection. Major repairs of BMP's shall be completed as soon as practical, and in-water work shall be stopped until repairs are complete.

3. If any BMPP is damaged, work will immediately be stopped and shall not resume until repairs to the BMPP have been completed.

9.18 Suspension of Work

1. Violations of any of the above requirements or any other pollution control requirements which may be specified in the Technical Specifications herein shall be cause for suspension of the work creating such violation. No additional compensation shall be due to the Contractor for remedial measures to correct the offense. Also, no extension of time will be granted for delays caused by such suspensions.

2. If no corrective action is taken by the Contractor within 72 hours after a suspension is ordered by the Owner, the Owner reserves the right to take whatever action is necessary to correct the situation and to deduct all cost incurred by the Owner in taking such action from monies due to the Contractor.

3. The Owner may also suspend any operations which he feels are creating pollution problems although they may not be in violation of the above-mentioned requirements. In this instance, the work shall be done by force account.

9.19 Contingency Plan

The following plan will be implemented by the General Contractor to prevent/respond to polluted discharges resulting from a severe storm or natural disaster. It is the General Contractors responsibility to abide by the following plan as well as any other binding plan, agreement, regulation, rule, law, or ordinance applicable.

All contractors associated with the following construction project, Sugar Cove Beach Maintenance, will follow this plan when a severe storm is either forecast or anticipated. General contractors must:

a. Regularly monitor local weather reports for forecasted and/or anticipated severe storm events, advisories, watches, warnings or alerts. The contractor shall inspect and document the condition of all erosion control measures on that day prior, during, and after the event. The contractor shall prepare for forecasted and/or anticipated severe weather events to minimize the potential for polluted discharges.
b. Secure the construction site. Securing the site should generally include:
    i. Removing or securing equipment, machinery, and maintenance materials.
    ii. Cleaning up all maintenance debris.
    iii. Implementing all Best Management Practices (BMPs) detailed in this BMPP. This includes BMPs for materials management, spill prevention, and erosion and sediment control.
c. In the event of a severe weather advisory (hurricanes, tropical storms, natural disasters) or when deemed necessary, cease regular construction operations. Work crews must finalize securing the project site, and evacuate until the severe weather condition has passed.
d. Upon return to the site, all BMPs shall be inspected, repaired, and/or re-installed as needed. If repair is necessary, it shall be initiated immediately after the inspection and repairs or replacement will be complete within 48 hours. To facilitate repair or replacement, the contractor will be required to store surplus material on the project site if the site is located where replacement materials will not be readily available.
e. When there either has been a discharge which violates Hawaii Water Pollution rules and regulations or there is an imminent threat of a discharge which violates Hawaii Water Pollution rules and regulations and/or endangers human and/or environmental health, the permittee shall at a minimum execute the following steps:
    i. Assess whether construction needs to stop or if additional BMPs are needed to stop or prevent a violation.
    ii. Take all reasonable measures to protect human and environmental health.
    iii. Immediately notify the DOH of the incident. The notification shall also include the identity of the pollutant sources and the implemented control or mitigation measures.
        1. Mr. Rich Salem – (808) 388-1300
        2. Operator/ Emergency Contact Number: TBD
        3. Department of Health

        Clean Water Branch (During regular working hours): 808-586-4309
        Hawaii State Hospital Operator (After hours): 808-247-2191

iv Document corrective actions, take photographs of discharge and receiving waters.

v. Revise Site Specific BMPs Plan to prevent future discharges of a similar nature.

9.20 Emergency Spill Response Plan

Pre-Emergency Planning

a. An initial and periodic assessment shall be made of the project site and potential hazardous spills that may be encountered during the normal course of work. This plan is not intended to address issues relating to materials such as PCB, Lead, Asbestos, etc., since these types of materials would have specific work plans already developed. This plan should be revised as necessary to correspond to the assessment and resubmitted to the appropriate regulatory agencies.
b. A Hazardous Materials inventory list and MSDS sheets, to include subcontractors' materials, will be filed in a binder and located in the Project Office. The inventory list and MSDS sheets will be updated and maintained by the Project Manager and site safety officer as new materials are added.
c. Personnel will consult the applicable MSDS sheet prior to its use.
d. Personnel will handle hazardous materials safely and use personal protective equipment (PPE), recommended/required by the MSDS, when handling hazardous materials.
e. Personnel will receive "Hazard Communication" training within three (3) working days of arrival and "product specific" training prior to the initial use/exposure of a product. This training will be conducted by the Project Manager/Superintendent or site safety officer.
f. All personnel will be trained on the contents of this plan within the first month of maintenance and at least annually thereafter. The training should include a rehearsal of this plan. An attendance sheet will be kept on file at the Project Office.
g. Only approved containers and portable tanks shall be used for storage and handling of flammable and combustible liquids. Approved safety cans or DOT approved containers shall be used for the handling and use of flammable liquids in quantities of five (5) gallons or less. For quantities of one (1) gallon or less, only the original container or approved metal safety can shall be used, for storage, use and handling of flammable liquids.
h. Flammable or combustible liquids shall not be stored in areas used for exits, stairways, or normally used for the safe passage of people.

Personal Protective and Emergency Spill Response Equipment

a. ABC fire extinguishers will be located in the project field office and in each of the company vehicles. There will be at least one fire extinguisher, rated at not less than 10B, within 50 feet of any stockpile of 5 gallons of flammable or combustible liquids or 5 pounds of flammable gas storage.

NOTE: Fire extinguishers should not be located "directly" with hazardous materials, so as to endanger first responders.

b. Spill kits will be located at the project field office and/or within 50 feet of the hazardous material storage area. The spill kit contents shall be determined by the Project Manager/Superintendent based on the anticipated hazardous materials to be stored and/or used on the project. The spill kits will be inventoried quarterly and appropriate logbook entries made.
c. Emergency response personal protective equipment (PPE) consists of:
    i. Face shield
    ii. Tyvek coveralls
    iii. Rubber gloves
    iv. Air-purifying respirators with HEPA and organic vapor combination cartridges will be issued to the Emergency Response Team members and maintained in the project office. Separate Respiratory Protection Equipment shall be designated and labeled as such; this equipment will be inspected at least every 30 calendar days and appropriate logbook entries made.

Personnel Roles, Lines of Authority and Communication

a. Emergency Response Coordinator (ERC)
    i. The Project Superintendent is the designated ERC. If the Project Superintendent is not available, the safety officer is the designated ERC.
    ii. The ERC will be in charge of and will coordinate the appropriate emergency response procedures in this plan.
b. Emergency Response Team (ERT)
    i. The ERT consists of Construction General Foreman, Labor Foreman, and a Laborer designated by the Project Superintendent.
    ii. The ERT will appropriately respond to the emergency in accordance with this plan at the direction of the ERC.

Emergency Alerting and Response Procedures

a. Any person causing or discovering a known hazardous or unknown release or spill will:
    i. Immediately alert nearby personnel who may be exposed to the effects of the release or spill.
    ii. Report the release or spill immediately to the ERC and the ERT. All pertinent information regarding the release should be provided to the ERC, such as the amount and type of material released, location of the release, and other factors, which may affect the response operation.
    iii. If the spill or release is a petroleum product or known non-toxic chemical, the person will take immediate and appropriate measures to stop or limit the rate of release, (i.e., close the spigot to the drum or form oil or curing compound) and or contain or stop the migration of the release (i.e., create a berm of dirt around the release) until the ERC and ERT arrive.
    iv. If the spill release is a toxic, highly flammable, or unknown chemical, the person will first notify the ERC before approaching the spill area from upwind to determine the source, type, and quantity of the release. The person should monitor the spill until the ERC and ERT arrive.

v. The ERC will assess possible hazards to human health or the environment that may result from the release, fire, or explosion.
vi. If the spill or release is less than 25 gallons of a known petroleum product or non-toxic chemical, the ERC will direct the ERT to contain and cleanup the spill or release.
vii. If the spill or release is toxic or unknown, the ERC will immediately notify the County of Maui Fire Department and ask for assistance from the HAZMAT Response Team.
viii. Immediately after the emergency, the ERC will arrange for disposing of the recovered waste, contaminated soil or any other material that results from the release, fire, or explosion at the project site in accordance with the County of Maui and State regulations and manufacturer's instructions (if source of spill or release is known).

Emergency Notification and Reporting Procedures

a. In the event that a release enters the storm or sewer system, the ERC will immediately notify the National Response Center (NRC) at 1-800-424-8802, and the Hawaii Department of Health, Hazard Evaluation and Emergency Response Office (HEER) at 808-586-4249.
b. The ERC will immediately notify appropriate agencies and submit written follow-up notification in accordance with the Hazardous Substance Release Notification Guideline.

Safe Distance Staging Area

a. A staging area at a safe distance upwind and higher than the location of the spill or release and its source will be immediately established.
b. Access to the spill or release location will be cleared for emergency vehicles and equipment to be used to contain and clean up the spill or release.

Site Security and Control

a. If the spill or release is located on or near the roadway, stop all traffic until the release is cleaned up.
b. If the spill or release is located away from vehicle or pedestrian traffic, install barricades/safety fencing around the affected area.
c. If the spill or release occurs during night operations, provide adequate light and use ground guides to escort emergency vehicles to the affected area.

Evacuation Routes and Procedures

a. Persons injured during the emergency condition will be evacuated to the staging area where they will be treated and or further evacuated to the nearest medical facility. The appropriate MSDS(s) will be provided to emergency service personnel and are intended to be delivered to the emergency room physicians.
b. Persons working at the affected area and who are not needed in the response effort will report to the staging areas for accountability.

Decontamination and Disposal Procedures

a. Persons involved in the spill clean-up are required to perform personal hygiene, utilizing soap and fresh water prior to eating, drinking, or smoking.
b. Contaminated PPE shall be appropriately cleaned and disinfected if possible. If this is not possible it shall be disposed of per the same requirements of the contaminated substance.
c. Sorbent pads/materials and the spilled substance will be placed in appropriate containers and disposed of as specified by the appropriate MSDS.
d. Contaminated soil will be placed in an appropriate container(s) or on plastic sheeting. The ERC will arrange with an environmental services company to properly characterize, prepare the manifest, label the containers, transport, and dispose of the contaminated soil. The generator's copy of the manifest will be kept in the project files for a minimum of three (3) years.
e. In the event of a substantial release (25 gallons or more) of a suspected or known toxic chemical, the Fire Department HAZMAT Response Team will be called to control/cleanup the release. They will establish and provide the decontamination operations as required.

Emergency Medical Treatment and First Aid

a. First aid kits will be maintained at the project field office, all company vehicles, and gang boxes.
b. Injured person(s) will be treated at the staging area by a certified first aid trained individual at the project site until the ambulance arrives or they are evacuated to the nearest medical facility.
c. The appropriate MSDS(s) will be provided to emergency service personnel and are intended to be delivered to the emergency room physicians.

After the Spill Procedures

a. The ERC will review what happened and implement changes, corrections, and/or improvements to prevent the spill from occurring and to improve the spill response and clean-up procedures. This plan will be revised to reflect those changes, corrections, and/or improvements implemented.
b. The ERC will prepare a record of the spill response and keep it in the project files for a minimum of three (3) years.
c. The ERC will submit Follow-up Notification to HEER when required.
d. Spill response kits shall be replenished directly after the emergency.

9.21 Emergency Contacts

National Response Center (NRC)		*1-800-424-8802*
Coast Guard Operations Center, Honolulu	(working hours) (after hours)	*1-808-522-8264* *1-808-927-0830*
Hawaii State Department of Health Hawaii Evaluation and Emergency Response (HEER)		*1-808-586-4249*
State Historic Preservation Division		*1-808-692-8015*
County of Maui Fire Department		*911*
In the event that a release enters the storm or sewer system, the ERC will immediately notify NRC and HEER		*1-808-935-2785*
Chris Conger, Design Engineer, Sea Engineering, Inc.		*1-808-259-7966*