REPORT ON

MONITORING OF THE SANDGRABBER TEST INSTALLATION

AT

KUALOA POINT, OAHU, HAWAII

SUBMITTED TO

MR. FRANK FISHEL

SANDGRABBER OF HAWAII, INC.

BEACH EROSION CONTROL SYSTEMS

841 Bishop Street, Suite 2121

Honolulu, Hawaii 96813

FEBRUARY 1978

WILSON
OKAMOTO
& ASSOCIATES

ENGINEERS
ARCHITECTS
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Honolulu, Hawaii

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By

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February 1978

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February 13, 1978

C2284-01

Mr. Frank Fishel
Sandgrabber of Hawaii, Inc.
841 Bishop Street, Suite 2121
Honolulu HI 96813

Dear Mr. Fishel:

Submitted for your approval is our final report on the monitoring results of the sandgrabber installation at Kualoa Point, including a brief commentary on the proposed extension of the installation around Kualoa Point where severe erosion is taking place.

The report concludes that the installation has been effective in protecting the test section of shoreline during the period from December 2, 1977, to January 18, 1978. This is clearly seen by the severe shoreline erosion landward of approximately 30 feet immediately east of the installation.

Net sand accumulations along the 200-foot test section during the period of observation are as follows:

12/2/77 to 12/06/77	+56 cubic yards
12/2/77 to 12/16/77	-17 cubic yards
12/2/77 to 1/18/78	+43 cubic yards

It has been a pleasure to furnish you with the monitoring and evaluation services for this new and innovative approach to solving the difficult and costly problem of shoreline erosion.

Sincerely,

WILSON OKAMOTO & ASSOCIATES, INC.

Henry Hoshide

Henry Hoshide
Director
Civil Engineering Department

HH:ct

cc: Robert Schieve

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PREFACE

Erosion of our shorelines has always occurred. With increased urbanization and attendant rise in land values, damage losses in this country due to shoreline erosion have risen into the millions of dollars in annual cost. The need for an effective, low cost erosion control system is immediate.

Out of this need has evolved the Sandgrabber system. The Sandgrabber system is a flexible permeable revetment built out of high-strength concrete masonry blocks that are held together with galvanized steel rods. The system differs from conventional revetments in that it allows a portion of the wave to flow through the structure. This is accomplished by facing the openings of the concrete masonry units to the ocean. By systematically offsetting the rows of blocks, the permeability of the structure can be controlled.

The permeable feature allows for both the passage of water and sediment through the structure and a partial absorption of wave energy. The intended result is to stop erosion to the back lying beach or land mass, and to induce deposition or accumulation of sediments both shoreward and seaward from the installation.

The Sandgrabber is usually installed on the existing shore along the low water line with only minor grading being accomplished to level the structure. The installation is usually gently curved shoreward and cresent shaped to prevent end runout of water that has passed through the structure.

A 200 foot Sandgrabber was installed at Kualoa for test purposes to its effectiveness to stop shoreline erosion and to accumulate sand.

OBJECT OF THE REPORT

The purpose of monitoring the installation was basically threefold.

- Objective one was to determine the effectiveness of the Sandgrabber system to stop erosion at Kualoa Park immediately behind the structure, and its capability to cause sand accretion. In conjuntion with this work, the profile of the installation was obtained periodically to determine vertical movements of the structure.

- Objective two was to observe the installation under varying tide, current, and wave conditions to verify stated capabilities of the system.

- Objective three was to note any deviations or unexpected conditions that may arise due to the particular nature of the site. Along with the observations would be an attempt to understand and to quantify the forces creating the situation.

DATA GATHERING PROCEDURE

A baseline survey was completed on December 2, 1977, on the day the structure was completed, just four days after start of construction. The structure is 200 feet long and slightly concaved to the ocean. Subsequent topographic surveys were taken on December 6, 1977; December 16, 1977; and January 18, 1977. (see Figures 1, 2, and 3). The Figures show graphically the changes in deposition and erosion during this period.

FACTORS AFFECTING DATES FOR DATA GATHERING

December 6, 1977, was selected because a noticeable buildup of sand had occurred.

During the period from December 2 to December 6, 1977, an ideal angle of wave attack occurred which was basically perpendicular to the shore, or generally easterly. This easterly wave is the angle that occurs most normally throughout the year. Figure 1 (Appendix A) shows the buildup experienced over this period.

Over the December 10th weekend and on into the following week, Mr. Schieve informed Wilson Okamoto & Associates that apparent south-easterly swells had attacked the installation resulting in erosion to the park at the south end of the structure. Figure 2, which is the survey taken on December 16, shows clearly the erosion to the park at the south end. Some loss of accreted sand at the south end also occurred.

During the period of December 16 to January 5, 1978, high north-northeast swells attacked the installation resulting in varying erosion of accreted sand along the south half of the installation. A short time earlier, the front row of masonry blocks was removed due to poor quality. Their removal resulted in the reduction of aligned holes from two rows to one row,before offsets in the cells occurred. The effect of this reduced the permeability of the structure and appeared to be one of exposing a "harder" surface to the incoming waves.

The final survey was conducted on January 18, 1978, and its results are noted on Figure 3. At the time of the survey, it appeared that an equilibrium situation had been restored. The easterly or more perpendicular to the shore swell, had returned and sand was again accumulating.

RESULTS OF SURVEY

Figures 1, 2, and 3 (Appendix A) show pictorially sand accumulations and losses from December 2, 1977, to January 18, 1978. The elevations shown on each Figure are for the specific survey date only and would have been different for any other day.

Quantity of gains and losses relative to the survey taken on December 2, 1977, which established the base line, are tabulated below.

Date	Accumulation (cubic yards)	Loss (cubic yards)	Net Gain or Loss (cubic yards)
December 6, 1977	56	--	+56
December 16, 1977	24*	41**	-17
January 18, 1978	81*	38**	+43

The profiles shown on Figures 2 and 3 also define the magnitude of settlement experienced by the Sandgrabber along it centerline. Maximum settlement of 0.9 foot was experienced along the Southern end during the observation period. The extreme south end settled somewhat more due to severe erosion at the immediate terminus point. This was considered a result of under and back washing of this end by adverse swells from the north-northeast.

During the period of the survey, the shoreline on both sides of the installation was also observed visually. Severe park erosion occurred at the immediate south terminus of the structure and continued around the point of the park. It is estimated that approximately 30 feet of land at the point has eroded into the sea during this brief time with the loss or relocation of many trees, loss of one dry well, and loss of one drinking fountain. The park section behind and to

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*Accumulations recorded principally along the north one-half of the installation.
**Losses recorded principally along the south one-third of the installation.

the north, however, appears to have remained stable, being protected by the Sandgrabber with only slight erosion to the park along the south half of the installation.

EVALUATION

The results of the survey and observations made during the period December 2, 1977, to January 18, 1978 indicated that the installed test Sandgrabber effectively protected and built-up the shoreline, at reasonable cost. The structure demonstrated its capability to endure adverse wave action and recover losses of accreted sand, even though on-site structural changes caused it to be less permeable. The flexible nature of the system allowed it to adjust to forces, thereby relieving or preventing the build-up of destructive stresses within the structure. This self adjustment to forces did not appear to reduce its effectiveness concerning the intended purpose of the installation. The study did indicate that certain factors should be carefully considered for future installations.

It appears essential that the optimum amount of energy absorption should occur in order to prevent a rapid build-up of littoral currents along the installation in the down-wind or down-drift direction. Reflection of too much wave energy from a hard surface tends to reinforce the horizontal component of subsequent waves to a point where erosive littoral velocities could be generated. Absorption of wave energy should be greater than the sum of littoral energy components of the incoming wave plus the reflected portion of the previous wave in order to have net deposition rather than net erosion. This means that the permeability of the structure is an important consideration.

Should the site be difficult, that is, the angle of wave attack is severely skewed from the perpendicular, the performance of the Sandgrabber approaches that of a conventional revetment. The initial directional placement of the system would have to consider wave angle attack and the anticipated erosive littoral currents. This is accomplished, if in fact erosion has been abated and sand is accreting, or the net result is deposition rather than erosion.

Materially, the installation requires quality components. An unexpected situation involved the delivery of poor quality cement masonry units that were used on the front row of the structure. The units were so weak that the normal process of bending the tie rods would break the blocks. Tighter material specifications should alleviate this problem.

The ease and speed of construction, use of unskilled labor, and basically "shelf item" materials attested to economy of the Sandgrabber system. Coupled with apparent effectiveness, this system provides an immediate low cost beach erosion control means.

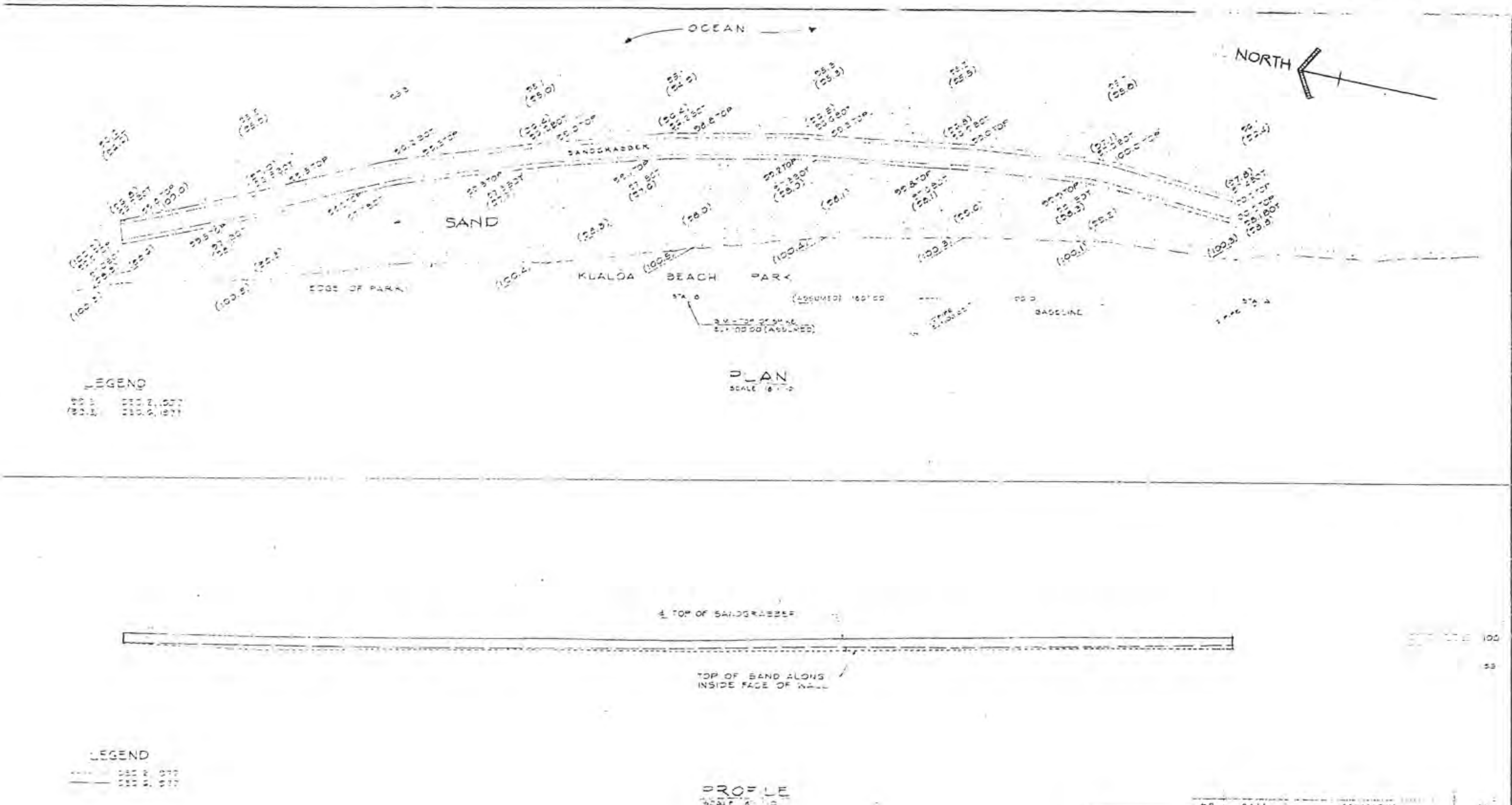
SUMMARY & CONCLUSIONS

1. The Sandgrabber works with nature by absorbing energy, rather than by confrontation or by repelling wave energy.
2. The test installation at Kualoa Beach Park has demonstrated its effectiveness to abate erosion of the Park directly behind it, and to cause accretion of sand behind and in front of it.
3. The directional placement of the structure was generally correct with regard to the more normally occurring easterly wave swell as the net effect (of wave attack angles, reflection, and littoral drift forces) has been accretion of sand rather than erosion. Some degree of directional placement improvement may be warranted to better compensate for the adverse winter north-northeast occurring swell.
4. Although some permeability was lost due to removal of the front row of blocks, toe scouring or front wash out as is the case with conventional revetments and pure "hard" surface seawalls was not evident.
5. The differential settling of the south end of the structure suggest that more design evaluation on how to terminate this end at this beach location is needed.
6. The Sandgrabber system is self healing due to its flexible design which allows relief from otherwise destructive, settling residual stresses. The maximum settlement which generally occurred along the south one-third of the installation during the observation period was 0.9 feet.
7. A net positive sand accumulation occurred during the evaluation period. A tendancy to recover lost sand (during adverse wave attack angles) was noted. Accretion continues during the more normal perpendicular easterly wave swell directions.

Author's footnotes/observations with regard to public acceptance and aesthetic quality:

1. Observations of sunbathers on the wall.
2. Fishermen and scuba divers use.
3. Beach in front and in back allows public parallel transit on the beach.
4. Basic pyramid design allows convenient steps for, to, and from transit to the water.
5. Aesthetically, sand has in part accumulated 2/3 the height of structure and, therefore, its dominance and contrast to the natural setting has been minimized. Accumulation is expected to continue.
6. For further aesthetic enhancement, construction of the structure below 0.0 MLLW elevation might be considered where wave angle of attack is severely skewed from the perpendicular, and the structure more closely approaches that of a conventional revetment. This may also provide a more stable base and minimize differential settlement which leads to erroneous conclusions.

APPENDIX A



SANDGRABBER OF HAWAII, INC.

FIGURE I

PLAN & PROFILE

12/2/77 TO 12/6/77

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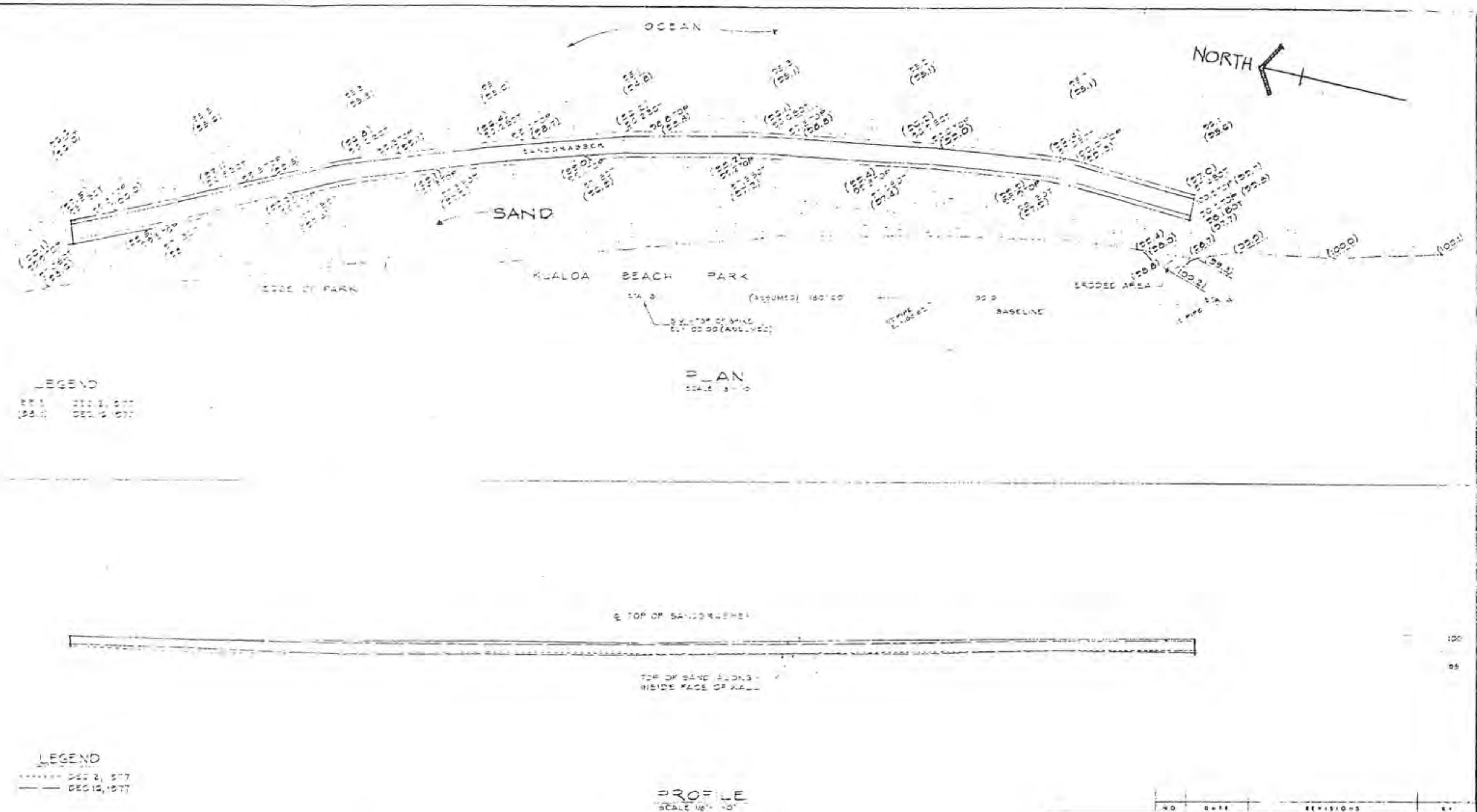

NO	DATE	REVISIONS	BY

SANDGRABBER OF HAWAII, INC.
FIGURE 2
PLAN & PROFILE
12/2/77 TO 12/16/77

DES
DWN R.N.
CHK
SUPV
DATE

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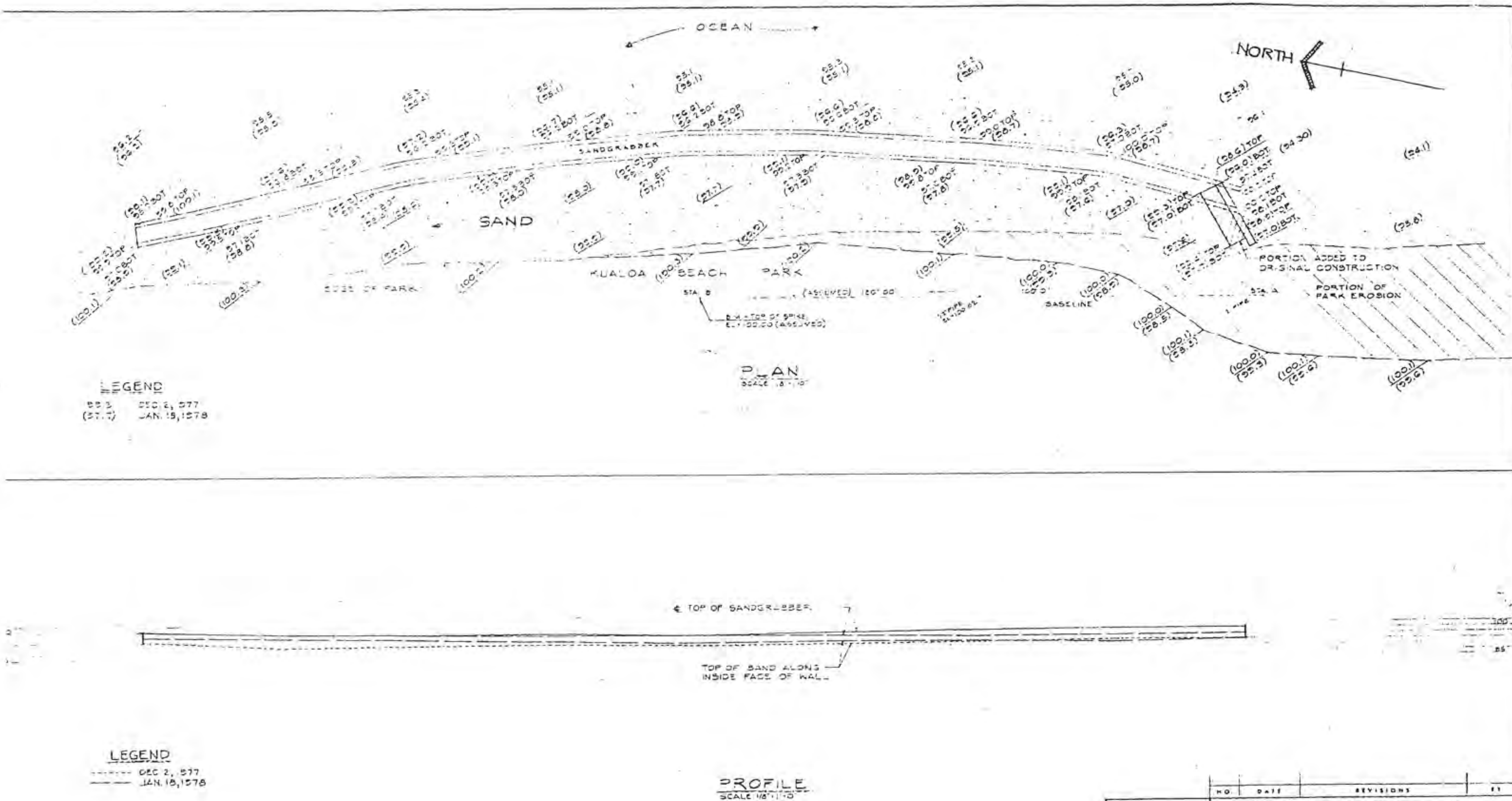
OF SHTS



NO.	DATE	REVISIONS	BY

SANDGRABBER OF HAWAII, INC.
FIGURE 3

PLAN & PROFILE
12/2/77 TO 1/18/78

DES.
DWN R.N.
CHK.
SUPV.
DATE

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