ENGINEER'S REPORT

GEOLOGIC HAZARD ABATEMENT DISTRICT – BROAD BEACH

(Pursuant to the Public Resources Code of the State of California, Section 26500 et seq.)

CERTIFICATION OF FILING

This report is presented at the direction of the Broad Beach GHAD (BBGHAD) Board of Directors. The BBGHAD is intended to provide monitoring and maintenance of improvements related to geologic hazard management within the BBGHAD and to levy and collect assessments in order to perform its activities.

The improvements, which are the subject of this report, are defined as any activity necessary or incidental to the prevention, mitigation, abatement, or control of a geologic hazard, construction, maintenance, repair, or operation of improvement; or the issuance and servicing of bonds issued to finance any of the foregoing (Pub. Resources Code § 26505).

This report consists of eight parts, as follows:

I. INTRODUCTION

II. BACKGROUND

III. GEOLOGIC HAZARD ABATEMENT DISTRICT DIAGRAM

IV. SERVICE LEVELS

V. SITE HISTORY

VI. DESCRIPTION OF THE IMPROVEMENTS TO BE IMPLEMENTED BY THE BBGHAD

VII. ASSESSMENT METHOD AND BENEFIT

VIII. ASSESSMENT LIMIT - BUDGET

The undersigned respectfully submits the enclosed Engineer's Report.

Date: June 22, 2017

By: ENGEO Incorporated

_______________, GE
Uri Eliahu

I HEREBY CERTIFY that the enclosed Engineer's Report was filed on the 23 day of July 2017.

____
Clerk of the Board
Broad Beach Geologic Hazard Abatement District
Malibu, California

I HEREBY CERTIFY that the enclosed Engineer's Report was approved and confirmed by the BBGHAD Board on the 23rd day of July, 2017.

____
Chairman of the Board
Broad Beach Geologic Hazard Abatement District
Malibu, California

APPROVED _______________

ENGEO
Expect Excellence

ENGINEER'S REPORT
for
BROAD BEACH GEOLOGIC HAZARD ABATEMENT DISTRICT
for the
ESTABLISHMENT OF AN ASSESSMENT LIMIT

I. INTRODUCTION

The Broad Beach Geologic Hazard Abatement District (BBGHAD) was formed by the Malibu City Council on September 12, 2011, pursuant to Resolution No. 11-41 under the authority of the California Public Resources Code, Division 17, Section 26500 et seq.

II. BACKGROUND

On November 6, 2011, pursuant to Resolution No. 2011/03, the BBGHAD Board of Directors approved the Broad Beach Plan of Control (BBGHAD Plan of Control) to allow the BBGHAD to permanently monitor and maintain BBGHAD improvements. The establishment of a real-property-related assessment to fund the BBGHAD responsibilities is described in this Engineer's Report. A previous Engineer's Report was prepared for the BBGHAD, dated January 18, 2012, and was adopted by the BBGHAD Board of Directors pursuant to Resolution No. 2012/02. In response to permitting requirements, an additional Engineer's Report was prepared dated July 15, 2015, and adopted by the BBGHAD Board of Directors pursuant to Resolution No. 2015/03.

III. GEOLOGIC HAZARD ABATEMENT DISTRICT BOUNDARIES

The legal description and boundaries for the BBGHAD are attached hereto and incorporated as Exhibits A and B.

IV. SERVICE LEVELS

The BBGHAD's activities are set forth in the Plan of Control and include certain activities necessary or incidental to the prevention, mitigation, abatement, or control of geologic hazards, including construction, retention, repair, or operation of any improvement, and the issuance and servicing of debt or bonds issued to finance any of the foregoing.

The BBGHAD provides for the administration and review of facilities within the budgeted limits, including the following services:

1. Oversight of BBGHAD operations.
2. In conjunction with the County Assessor's Office, setting the annual levying of assessments on the property tax roll.
3. Engagement of technical professionals to perform the monitoring duties as described in the BBGHAD Plan of Control and as required by various governmental agencies.

4. Performance of BBGHAD construction activities in accordance with the BBGHAD Plan of Control. These activities include, but are not limited to, the following.
   - Beach nourishment and sculpting
   - Construction/restoration of dunes and related natural habitat
   - Beach drainage improvements

5. Performance of BBGHAD preservation activities in accordance with the BBGHAD Plan of Control. These activities include, but are not limited to, the following.
   - Inspection of revetment structures
   - Inspection and preservation of restored dunes.
   - Monitoring of accumulated erosion and beach recession.

6. Preparation of annual BBGHAD budgets.

V. SITE HISTORY

The Broad Beach area is located at the base of the Santa Monica Mountains and adjacent to Santa Monica Bay in Malibu, western Los Angeles County, California, extending from Point Lechuza on the west to Zuma Beach on the east. Although beach width can vary seasonally as well as from year to year, Broad Beach has been consistently narrowing in width since the early 1970s. The historically wide beach has gradually narrowed due to an imbalance in the sediment budget, i.e., more sand has left the beach system over the past 40 years than entered it. Since the mid-1970s, Broad Beach has lost an average of 20,000 cubic yards per year. This rate accelerated between 2004 and 2009 to approximately 35,000 cubic yards per year. As reported by Moffatt & Nichol, the Engineer of Record for the proposed improvements, Broad Beach is a very narrow ribbon of sand visible primarily at low tide but inundated at moderate to high tide (Moffatt & Nichol, 2017 (Exhibit D)).

In general, very little, if any, dry beach exists at higher tide levels. Various portions of the beach have been subjected to emergency repair/protective measures in years past due to storms and related erosion events. Temporary armoring (including sandbags) from earlier emergency repairs became increasingly exposed with time, and was subsequently removed or augmented with more robust shoreline protection. An emergency rock revetment was installed seaward of 78 Broad Beach parcels in 2010 to protect the private properties (Moffatt & Nichol, 2017).

Because of the general and continuing narrowing of the beach, private improvements, including homes, are threatened by high tides and continuing wave action. In order to reduce the risk of damage and/or destruction of these improvements, a beach and dune restoration program will be implemented.

Beaches essentially act as coastal storm barriers. A beach's size, shape, and sand volume help determine how well the beach can protect a developed area during a storm. The various elements of a beach, including vegetated dunes, the flat portion of the dry sand beach and offshore sand bars, offer a level of natural protection against coastal storms by absorbing and dissipating the energy of breaking waves, either seaward on an offshore bar or directly on the beach itself. To restore the energy-dissipation components to the beach, additional protective measures will be implemented. The profile and geometry of the contemplated beach restoration project ("Project") have been designed for the protection of private improvements within the BBGHAD (Moffatt & Nichol, 2017).

VI. DESCRIPTION OF THE IMPROVEMENTS TO BE IMPLEMENTED BY THE BBGHAD

A. Beach Nourishment

The BBGHAD-maintained improvements are described in the BBGHAD Plan of Control. In general, these improvements include the following:

- Sand Nourishment and Beach Replenishment – placing beach material to replenish Broad Beach with "dry" sand between the dune system and shoreline.
- Revetment – Relocating the eastern 1,600-foot reach and burying the full revetment in the landward edge of the widened, nourished beach. The cost of relocation and burying of the existing revetment will be borne by the affected landowners and will not be paid by GHAD assessments. "After-the-fact" permitting would be undertaken to classify the revetment as a permanent feature. Imported beach quality material would be placed over the existing revetment to create a restored dune.
- Inland Beach Material Sourcing and Transport – Sourcing beach compatible material at an inland site or sites.
- Dune Building and Restoration – Building a reservoir of sand and restoring dune habitat with native plant species.

Protection of the beach, dunes, structures, and infrastructure will require nourishment of the beach and restoration of historic dunes and/or improvement of existing dunes. Beach nourishment and sculpting will restore the width of the beach and provide a protective barrier for structures and properties, as well as inward stretches of the beach. The habitat restoration, incorporating native vegetation, will reduce erosion to the dune and beach face. When completed, these improvements will repair existing damage and reduce future inundation- and erosion-related damage from storm surges, wave run-up, and overtopping, as described below.

The Project will include approximately 300,000 cubic yards of sand nourishment, which will provide approximately 70 feet of dry sand beach seaward of the seaward toe of the restored dune system. Like most beach nourishment projects, the beach will gradually lose sand. Studies indicate that Broad Beach is currently losing sand at a rate of approximately 35,000 cubic yards per year. Thus, while the sand will deplete at different rates depending on weather, tides, and many other factors, a 300,000-cubic-yard initial nourishment, coupled with permitted backpassing and interim nourishments, should last for the 5-year interval prior to the next major re-nourishment event (Moffatt & Nichol, 2017).

While multiple viable sand sources exist, the preferred source of beach-quality sand has been identified; the proposed source for medium-grain sand is a private local commercial quarry (CEMEX, "Local Inland Source") in the Moorpark/Simi area of the Simi Valley, 20 to 25 miles north of the Project site by air and 40 to 45 miles north of the Project site by truck (Moffatt & Nichol, 2017).

B. Monitoring and Sand Backpassing

A proactive beach monitoring plan is critical to the success of the nourishment project. An important element of the Project is the implementation of a sand backpassing program. Since the beach is not anticipated to erode at the same rate along its length, periodic re-distribution of the sand to "even-out" the resource will be implemented.

The BBGHAD shall be responsible for the monitoring of the restored beach and dunes. The BBGHAD's monitoring responsibilities include prevention, abatement, and control of erosion hazards as well as vegetation control within the Project area.

The BBGHAD's general preservation responsibilities will include:

- Inspection of revetment structures
- Inspection and maintenance of restored dunes
- Monitoring of accumulated erosion and beach recession
- Monitoring of Project impacts in accordance with governmental oversight

Specifics regarding the beach monitoring and backpassing operations are presented in Exhibit D.

Small-scale interim renourishments will occur in accordance with objective triggers as described in Exhibit D "interim renourishment milestone." Beach widths measured from various transects, supplemented with surveyed beach profile data, will be analyzed to determine when this interim renourishment milestone is met.

Prior to the scheduled renourishment of up to 300,000 cubic yards at or around year 5, and subsequent 300,000-cubic-yard planned renourishments at years 10 and 15, the need may arise for the placement of additional sand along Broad Beach to maintain Project objectives. Small-scale renourishments are proposed as an adaptive management action when beach width along the western portion of Broad Beach has narrowed to the point where seasonal fluctuations in beach width could result in revetment exposure and limited lateral beach access. Additional details of planned renourishments and interim renourishments are provided in Exhibit D.

VII. ASSESSMENT METHOD AND BENEFIT

A. Special Benefit and Proportionality

The improvements described in this document will confer some or all of the following special benefits to the assessed parcels:

1. Protection from erosion due to wave action.
2. Protection from flooding associated with storms.
3. Protection from sea-level rise.
4. Availability to access and use the beach facility.
5. Prevention of blight.
6. Consequential protection of properties to the west of the beach improvements to the extent of natural littoral movement.

The BBGHAD improvements described in Section VI are distributed within the BBGHAD boundaries. Implementation and protection of these improvements provide a special benefit to all real property assessed within the BBGHAD. As a means of protection from erosion, flooding from sea level rise and storms, tsunamis, and wave action, the proposed beach improvements will provide protection to private property improvements within the BBGHAD, including homes and the Malibu West Beach Club and, therefore, will provide a special benefit to property owners within the BBGHAD. Properties to the west of 31138 Broad Beach Road will receive a reduced special benefit and will be assessed less accordingly. Properties to the west of 31380 will receive a further diminished special benefit, with a further reduced assessment. Two parcels devoted exclusively to public access walkways ("public access parcels") also receive a reduced benefit, limited to point 4 above. These improvements are special benefits conferred on all the assessed parcels in the BBGHAD. These improvements affect the assessed property in a way that is particular and distinct from their effect on other parcels, and real property in general and the public at large do not benefit or share.

Property owners derive special benefit based in direct proportion to their respective beach frontage. Although volumes of sand placement may differ from time to time on each parcel, the dynamic nature of beach erosion, subsequent sand transport, the anticipated backpassing maintenance, and interim sand nourishment activities render the environment within the BBGHAD district boundaries as a semi-closed, discrete system in which special benefit is provided along the coastal property line for the benefit of coastal properties and is therefore derived based on proportional beach frontage. The propensity to erode is based on coastal exposure; thus, protection from erosion is also based on coastal exposure — foot frontage of coast. Therefore, owners with greater beach frontage derive greater special benefit than owners with lesser beach frontage. Moffatt & Nichol finds that the proposed improvements and activities equalize the special benefit derived by properties within the BBGHAD based on pro-rata length of beachfront per assessed parcel, with reduced special benefit to properties to the west of 31138 Broad Beach Road, to the west of 31380 Broad Beach Road, and the public access parcels as stated above.

The special benefit is proportional to the length of beach frontage and the extent of BBGHAD-placed sand nourishment, regardless of the presence of pre-existing protective structures, such as revetments or seawalls. As described by representatives of Moffatt & Nichol (the Engineer of Record for the proposed improvements), the proposed beach nourishment Project will directly benefit the performance and longevity of existing seawalls within the BBGHAD district in two important ways. First, the beach nourishment is adding soil to the seaward side of an existing seawall, thereby acting to better balance the soil pressures that act upon the landward side of the wall. Second, adding sand to a beach fronting a seawall that has been denuded of sand will move the wave-breaking impact area seaward and away from directly impinging on the seawall. The wider beach will allow wave energy to dissipate more gradually on the sloping sand beach, thereby reducing environmental loading on the seawall structure.

There is no special benefit for properties outside of the district.

We must also distinguish between the public benefit necessary to allow permitting of the Project and the "general benefit" contemplated by Article XIII D of the California Constitution. We conclude the Project will create no general benefit in the latter sense, but that it will have sufficient public benefit to allow its entitlement.

To be conservative in our analysis, however, we also evaluate the value of any putative general benefit under Article XIII D of the California Constitution the Project might arguably create and, for the reasons stated below, conclude the cost of any such general benefit will not be recovered from assessment proceeds, but from non-assessment revenues.

Like most assessments, special benefits conferred by the improvements may have the effect of creating incidental general benefits (i.e., an improved beach area that the public may use). However, the additional beach area created by the improvements contemplated here is not a general benefit within the contemplation of Article XIII D of the California Constitution. The fact that a particular improvement project does not confer any such general benefit on the community at large does not make the Project any less public in the sense required to allow assessment funding or to permit Coastal Commission, State Lands Commission and other government approvals of the Project. The California Coastal Commission and the State Lands Commission both explicitly conditioned their approvals of the contemplated improvements on the creation of additional beach area accessible to the public, as required by the statutes under which they act. Thus, although the additional beach area may be publicly accessible, it is a legally compelled portion of the Project required to achieve the special benefit running to property owners; without additional beach area, the Coastal Commission and State Lands Commission would not permit the Project to achieve the special benefit.

If the additional beach area were construed as a general benefit within the meaning of Article XIII D of the California Constitution, that benefit is incidental. Of the parcels within the BBGHAD, approximately 47 non-contiguous parcels currently allow for lateral public access, and those parcels are remotely located with limited access to public transportation and public parking. Further, the cost to confer the incidental general benefit is exceeded by a non-assessment funding source for the Project. The cost of revetment relocation, estimated at $2.4 million, as presented in Exhibit D, will be borne by the private landowners who hold title to property on which portions of the revetment will be relocated. This funding source will offset the general benefit realized by the public.

In recognition of the incidental nature of any general benefit (within the meaning of Article XIII D of the California Constitution) resulting from the Project, we determine that the value of the general benefit is no more than 2 percent of the total benefit generated by the Project. Although the Project has no stated termination date, the California Coastal Commission approved the Project for 10 years, and is anticipated to continue to approve the Project in 10-year increments, with Executive Director "check-ins" every 5 years. In any event, it is unduly speculative to predict costs and available resources more than 20 years into the future. Project-related construction expenses for a 20-year horizon have been estimated to be approximately $94 million (2017 dollars). Therefore, the portion of Project cost attributable to this putative and incidental general benefit is, in our professional judgment, no more than 2 percent, or approximately $1.88 million.

Also, the special benefit conveyed to the non-assessed public access parcels is a reduced amount (related to point 4 discussed above) of the per-foot assessment value presented in Exhibit C) for the combined 40-foot parcel width. However, even if the public access parcels were to conservatively receive 50 percent of the full benefit valued at $515.63 (50 percent of the $1,031.25 assessment per linear foot of beach frontage in these areas), as discussed in Section VIII below, this would amount to only $20,625.20 during the first year, with a 20-year horizon estimated at $412,504 total in 2017 dollars.

Therefore, the non-assessment costs of revetment relocation ($2.4 million), borne by the affected homeowners, offers a contribution that more than offsets the incidental general benefit.

B. Assessment Method

Lots will be assessed based on the length of their respective beach frontages; the assessment will be based on a unit rate times the linear footage of beach frontage. Based on the reduced special benefit that will be derived west of 31138 Broad Beach Road described above, and the further reduced special benefit derived west of 31380 Broad Beach Road, those property owners will be assessed a lower assessment measured as a percentage of the assessment paid by other landowners within the BBGHAD.

VIII. ASSESSMENT LIMIT - BUDGET

A financial analysis was performed to provide a framework for an operating budget for the on-going abatement, mitigation, prevention, and control of geologic hazards within the BBGHAD boundaries. In preparation of the budget, several factors were considered including:

- Proposed Improvements
- Elements Requiring Preservation

Based on the estimated expenses for on-going operations and the allowance for one future beach re-nourishment event (5 years after the initial re-nourishment), a budget was prepared for the purpose of estimating initial assessment levels (Exhibit C). The budget is based on cost estimates provided at the time of preparation of this Engineer's Report with respect to materials, labor, and related costs within a reasonably foreseeable timeline of anticipated Project commencement. Because of uncertainty related to the dates on which the BBGHAD will obtain required Project permits and, subsequently, begin construction, the Project costs and related assessment have been adjusted to allow for a potential delay of the issuance of necessary permits and/or the commencement of Project construction in fall 2017.

The Engineer recommends an annual assessment limit of $1,375 per foot of beach frontage for each residential lot beginning at 31138 Broad Beach Road and all lots eastward (Fiscal Year 2017 dollars). Based on the reduced special benefit to westerly properties described above, the assessment limit for parcels starting at 31202 Broad Beach Road and westward to 31380 Broad Beach Road will be set at 75 percent of the value for the remaining frontage, and the assessment limit for parcels to the west of 31380 Broad Beach Road will be set at 25 percent of the value for the remaining frontage. Both percentages have been established in the professional judgment of the BBGHAD Manager and Assessment Engineer (ENGEO) and the BBGHAD Engineer, Moffatt & Nichol. Further details are provided in Exhibit D. Inherently, the determination of the fractional assessment assigned to parcels to the west of 31138 Broad Beach Road and further to the west of 31380 Broad Beach Road is based on a qualitative analysis of several factors discussed in this document. During this determination, a confirming quantitative assessment was concurrently performed. However, the quantitative assessment must be qualified: it is not to be interpreted as a statement of precision; rather, it was performed to clarify and facilitate validation of the qualitative analysis.

In the event that the assessment described in this document is not approved by vote of the property owners within the BBGHAD, the existing assessment will remain in place. The Assessment Diagram is shown in Exhibit E. The proposed initial assessment level will be adjusted annually to reflect the percentage change in the Los Angeles metropolitan area Consumers Price Index (CPI) for All Urban Consumers. The assessment limit will be adjusted annually using an initial date of April 2017 for the CPI. Each subsequent annual adjustment will be calculated using the 12-month period from April to April. The assessment shall be levied by the BBGHAD following the authorization of the assessment.

EXHIBIT A

Legal Description

EXHIBIT "A"
LEGAL DESCRIPTION

IN THE COUNTY OF LOS ANGELES, STATE OF CALIFORNIA, BEING THAT PORTION OF THE RANCHO TOPANGA MALIBU SEQUIT, AS CONFIRMED TO MATTHEW KELLER BY PATENT, RECORDED IN BOOK 1, PAGE 407 ET SEQ. OF PATENTS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE NORTHERLY PROLONGATION OF THE EASTERLY TRACT LINE OF TRACT NO. 12314, RECORDED IN BOOK 232, PAGES 23 AND 24, OF MAPS, IN THE OFFICE OF SAID COUNTY RECORDER WITH THE SOUTHERLY LINE OF THAT 60-FOOT STRIP OF LAND DEEDED TO SAID COUNTY OF LOS ANGELES, BY DEEDS RECORDED IN BOOK 21735, PAGE 135 AND IN BOOK 21722, PAGE 190 OF OFFICIAL RECORDS IN THE OFFICE OF SAID COUNTY RECORDER;

THENCE WESTERLY ALONG SAID SOUTHERLY LINE PARALLEL WITH THE CENTERLINE OF BROAD BEACH ROAD THE FOLLOWING 4 COURSES:

1. NORTH 55°10'30" WEST 693.12 FEET TO THE BEGINNING OF A CURVE TANGENT WITH SAID LINE, CONCAVE SOUTHERLY, AND HAVING A RADIUS OF 1980.00 FEET;
2. WESTERLY 290.86 FEET ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 08°25'00" TO THE BEGINNING OF A LINE TANGENT WITH SAID CURVE;
3. NORTH 63°35'30" WEST 530.42 FEET;
4. NORTH 64°54'00 WEST 625.20 FEET TO THE INTERSECTION OF THE NORTHERLY PROLONGATION OF THE WESTERLY TRACT LINE OF SAID TRACT NO. 12314 WITH THE SOUTHERLY LINE OF SAID 60-FOOT STRIP OF LAND;

THENCE ALONG SAID SOUTHERLY LINE NORTH 64°54'00" WEST 107.00 FEET TO THE NORTHEASTERLY CORNER OF TRACT NO. 12909, RECORDED IN BOOK 263, PAGES 37 AND 38, OF MAPS, IN THE OFFICE OF SAID COUNTY RECORDER;

THENCE ALONG THE NORTHERLY LINES OF SAID TRACT NO. 12909 THE FOLLOWING 5 COURSES:

1. NORTH 64°54'00" WEST 307.62 FEET TO THE BEGINNING OF A CURVE TANGENT WITH SAID LINE, CONCAVE SOUTHERLY, AND HAVING A RADIUS OF 1974.15 FEET;
2. WESTERLY ALONG SAID CURVE 199.27 FEET THROUGH A CENTRAL ANGLE OF 05°47'00" TO THE BEGINNING OF A LINE TANGENT WITH SAID CURVE;
3. NORTH 70°41'00" WEST 672.67 FEET TO THE BEGINNING OF A CURVE TANGENT WITH SAID LINE, CONCAVE SOUTHWESTERLY, AND HAVING A RADIUS OF 2980.00 FEET;
4. WESTERLY ALONG SAID CURVE 615.90 FEET THROUGH A CENTRAL ANGLE OF 11°50'30" TO THE BEGINNING OF A LINE TANGENT WITH SAID CURVE;
5. NORTH 82°31'30 WEST 615.67 FEET TO THE NORTHEASTERLY CORNER OF TRACT NO. 31986, RECORDED IN BOOK 1081, PAGES 78 AND 79 OF MAPS, IN THE OFFICE OF SAID COUNTY RECORDER;

THENCE ALONG THE NORTHERLY LINES OF SAID TRACT NO. 31986 NORTH 82°31'30" WEST 118.84 FEET TO THE NORTHWESTERLY CORNER OF SAID TRACT NO. 31986;

THENCE ALONG SAID SOUTHERLY LINE NORTH 82°31'30" WEST 105.00 FEET TO THE NORTHEASTERLY CORNER OF TRACT NO. 32003, RECORDED IN BOOK 1081, PAGES 28 AND 29, OF MAPS, IN THE OFFICE OF SAID COUNTY RECORDER;

THENCE ALONG THE NORTHERLY LINES OF SAID TRACT NO. 32003 NORTH 82°31'30" WEST 300.02 FEET TO THE NORTHEASTERLY CORNER OF TRACT NO. 25166, RECORDED IN BOOK 695, PAGES 29 THROUGH 31, OF MAPS, IN THE OFFICE OF SAID COUNTY RECORDER;

THENCE ALONG THE EASTERLY LINE OF SAID TRACT NO. 25166 SOUTH 07°28'30" WEST 65.06 FEET TO THE NORTHEASTERLY CORNER OF LOT 16 OF SAID TRACT NO. 25166;

THENCE ALONG THE NORTHERLY LINES OF SAID LOT 16 THE FOLLOWING 2 COURSES:

1. NORTH 84°58'01" WEST 131.25 FEET;
2. SOUTH 76°12'50" WEST 31.00 FEET TO THE EASTERLY END OF THE CENTERLINE OF VICTORIA POINT ROAD (A PRIVATE ROAD) PER SAID TRACT NO. 25166;

THENCE ALONG SAID VICTORIA POINT ROAD CENTERLINE THE FOLLOWING 5 COURSES:

1. NORTH 17°26'00" WEST 11.00 FEET;
2. SOUTH 72°34'00" WEST 105.92 FEET TO THE BEGINNING OF A CURVE TANGENT WITH SAID LINE, CONCAVE SOUTHEASTERLY, AND HAVING A RADIUS OF 1000.00 FEET;
3. SOUTHWESTERLY ALONG SAID CURVE 134.68 FEET THROUGH A CENTRAL ANGLE OF 07°43'00" TO THE BEGINNING OF A LINE TANGENT WITH SAID CURVE;
4. SOUTH 64°51'00" WEST 68.42 FEET TO THE BEGINNING OF A CURVE TANGENT WITH SAID LINE, CONCAVE NORTHWESTERLY, AND HAVING A RADIUS OF 100.00 FEET;

5. SOUTHWESTERLY ALONG SAID CURVE 51.65 FEET THROUGH A CENTRAL ANGLE OF 29°35'30" TO THE MOST NORTHWESTERLY CORNER OF LOT 7 OF SAID TRACT NO. 25166;

THENCE ALONG THE WESTERLY LINES OF SAID LOT 7 THE FOLLOWING 3 COURSES:

1. SOUTH 04°26'30' WEST 110.00 FEET;
2. SOUTH 56°26'55" WEST 59.24 FEET;
3. SOUTH 32°46'52" EAST 15.00 FEET TO THE MOST WESTERLY CORNER OF LOT 6 OF SAID TRACT NO. 25166;

THENCE ALONG THE SOUTHWESTERLY LINES OF SAID LOT 6 THE FOLLOWING 3 COURSES:

1. SOUTH 32°46'52" EAST 12.00 FEET;
2. NORTH 57°13'08" EAST 16.36 FEET;
3. SOUTH 40°20'10" EAST TO THE MEAN HIGH TIDE LINE OF THE PACIFIC OCEAN;

THENCE NORTHERLY, NORTHEASTERLY, AND EASTERLY ALONG THE MEAN HIGH TIDE LINE OF THE PACIFIC OCEAN AND ALONG THE SOUTHERLY LINES OF THE LAND DESCRIBED IN THE FOLLOWING TRACTS AND DEEDS:

1. SAID TRACT NO. 25166;
2. SAID TRACT NO. 32003;
3. SAID TRACT NO. 31986;
4. SAID TRACT NO. 12909;
5. GRANT DEED 00-0644320 RECORDED APRIL 28, 2000 IN THE OFFICE OF SAID COUNTY RECORDER;
6. GRANT DEED 04-0646973 RECORDED MARCH 18, 2004 IN THE OFFICE OF SAID COUNTY RECORDER;
7. SAID TRACT NO. 12314;
8. GRANT DEED 20072854217 RECORDED DECEMBER 28, 2007 IN THE OFFICE OF SAID COUNTY RECORDER;
9. GRANT DEED 96-1557431 RECORDED SEPTEMBER 23, 1996 IN THE OFFICE OF SAID COUNTY RECORDER;
10. GRANT DEED 3411 RECORDED APRIL 03, 1967 IN THE OFFICE OF SAID COUNTY RECORDER;
11. GRANT DEED 20080278549 RECORDED FEBRUARY 02, 2008 IN THE OFFICE OF SAID COUNTY RECORDER;
12. GRANT DEED 3527 RECORDED DECEMBER 30, 1958 IN THE OFFICE OF SAID COUNTY RECORDER;
13. GRANT DEED 05-1153695 RECORDED MAY 17, 2005 IN THE OFFICE OF SAID COUNTY RECORDER;
14. GRANT DEED 20080934875 RECORDED MAY 28, 2008 IN THE OFFICE OF SAID COUNTY RECORDER;
15. GRANT DEED 20091411424 RECORDED SEPTEMBER 16, 2009 IN THE OFFICE OF SAID COUNTY RECORDER;
16. GRANT DEED 99-2390992 RECORDED DECEMBER 29, 1999 IN THE OFFICE OF SAID COUNTY RECORDER TO THE EASTERLY LINE OF THE LAND DESCRIBED IN SAID GRANT DEED 99-2390992;

THENCE ALONG SAID EASTERLY LINE OF THE LAND DESCRIBED IN SAID GRANT DEED 99-2390992 NORTH 36°37'30" EAST TO A NON TANGENT CURVE CONCAVE NORTHEASTERLY, AND HAVING A RADIUS OF 10,050.00 FEET, SAID CURVE ALSO BEING THE SOUTHERLY LINE OF THE 100 FOOT WIDE STRIP OF LAND (PACIFIC COAST HIGHWAY) CONVEYED TO THE STATE OF CALIFORNIA BY THE DEED RECORDED IN BOOK 20716 PAGE 385, OF OFFICIAL RECORDS;

THENCE WESTERLY ALONG SAID SOUTHERLY LINE OF THE 100 FOOT WIDE STRIP OF LAND THE FOLLOWING 2 COURSES:

1. NORTHWESTERLY ALONG SAID CURVE 208.29 FEET THROUGH A CENTRAL ANGLE OF 01°11'15";
2. NORTH 48°39'15" WEST 228.77 FEET TO THE INTERSECTION OF THE NORTHERLY PROLONGATION OF THE EASTERLY LINE OF THE LAND DESCRIBED IN SAID GRANT DEED 3411 WITH THE SAID SOUTHERLY LINE OF THE 100 FOOT WIDE STRIP OF LAND;

THENCE ALONG SAID NORTHERLY PROLONGATION OF THE EASTERLY LINE OF THE LAND DESCRIBED IN SAID GRANT DEED 3411 SOUTH 34°49'30" EAST 10.07 FEET TO THE NORTHEASTERLY CORNER OF THE LAND DESCRIBED IN SAID GRANT DEED 3411;

THENCE ALONG THE NORTHERLY LINE OF THE LAND DESCRIBED IN SAID GRANT DEED 3411 NORTH 48°39'15" WEST TO THE NORTHWESTERLY CORNER OF THE LAND DESCRIBED IN SAID GRANT DEED 3411;

THENCE ALONG THE WESTERLY LINE OF THE LAND DESCRIBED IN SAID GRANT DEED 3411 SOUTH 34°49'30" WEST 32.91 FEET TO THE SAID SOUTHERLY LINE OF THE 60-FOOT STRIP OF LAND PARALLEL WITH BROAD BEACH ROAD;

THENCE ALONG THE SAID SOUTHERLY LINE OF THE 60-FOOT STRIP OF LAND PARALLEL WITH THE CENTERLINE OF BROAD BEACH ROAD NORTH 55°10'30" WEST 121.95 FEET TO THE **POINT OF BEGINNING.**

AS SHOWN ON THE ATTACHED EXHIBIT "B" AND BY THIS REFERENCE MADE A PART HEREOF.

SUBJECT TO ALL COVENANTS, RIGHTS, RIGHTS-OF-WAY, AND EASEMENTS OF RECORD, IF ANY.

THIS REAL PROPERTY DESCRIPTION HAS BEEN PREPARED BY ME, OR UNDER MY DIRECTION, IN CONFORMANCE WITH THE PROFESSIONAL LAND SURVEYOR'S ACT.

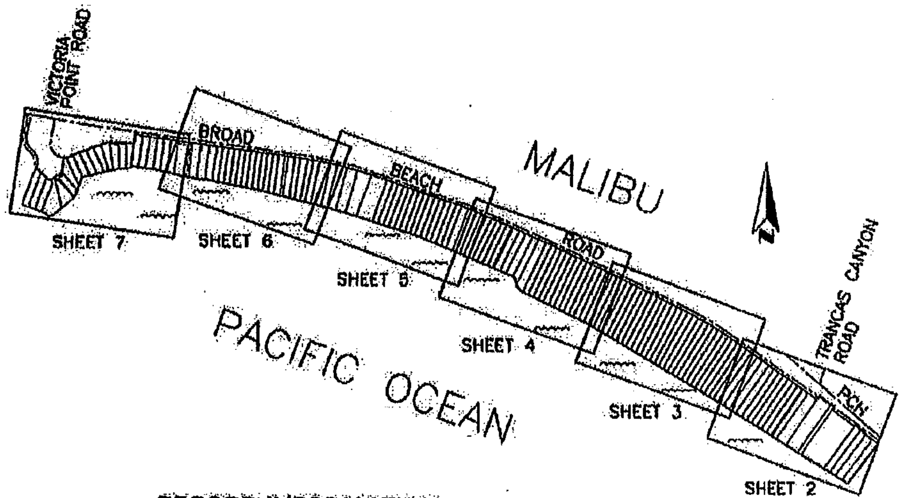
FINAL ELECTRONIC COPY 3/15/11
RICHARD C. MAHER, PLS 7564 DATE
THIS DOCUMENT IS PRELIMINARY UNLESS SIGNED

KDM MERIDIAN, INC.
(949) 768-0731

EXHIBIT B

BBGHAD Boundary

03/14/11	EXHIBIT "B" PLOT TO ACCOMPANY LEGAL DESCRIPTION	SHEET 1 OF 7



RECORD INFORMATION

THE CENTERLINES, RIGHTS-OF-WAY, AND PROPERTY LINES SHOWN HERON ARE BASED ON THE FOLLOWING RECORD MAPS AS FILED IN THE OFFICE OF THE LOS ANGELES COUNTY RECORDER:

TRACT NO. 12314	BOOK 232	PAGES 23-24
TRACT NO. 12909	BOOK 263	PAGES 37-38
TRACT NO. 31986	BOOK 1081	PAGES 78-79
TRACT NO. 32003	BOOK 1081	PAGES 28-29
TRACT NO. 25166	BOOK 695	PAGES 29-31
RECORD OF SURVEY	BOOK 76	PAGES 20-21
F.M. 11698-1		PAGES A1-A8
F.M. 11260-2		PAGES A1-A13

DEEDS REFERENCED AS XX-XXXXXXX INDICATE RECORDED INSTRUMENT NUMBER IN THE LOS ANGELES COUNTY RECORDERS OFFICE.

⚠ 80-FOOT STRIP OF LAND DESCRIBED IN DEEDS RECORDED IN BOOK 21735, PAGE 135 AND BOOK 21722, PAGE 190, FILED IN THE OFFICE OF THE LOS ANGELES COUNTY RECORDER

LINE TABLE

LINE	BEARING	DISTANCE
L1	S07°28'30"W	65.06'
L2	N84°58'01"W	131.25'
L3	S76°12'50"W	31.00'
L4	N17°26'00"W	11.00'
L5	S72°34'00"W	105.92'
L6	S64°51'00"W	68.42'
L7	S04°26'30"W	110.00'
L8	S56°26'55"W	59.24'
L9	S32°46'52"E	27.00'
L10	N57°13'08"E	16.36'
L11	S34°49'30"W	10.07'
L12	N48°39'15"W	100.66'
L13	S34°49'30"W	32.91'
L14	N55°10'30"W	121.95'

CURVE TABLE

CURVE	DELTA ANGLE	ARC LENGTH	RADIUS
C1	7°43'00"	134.68'	1000.00'
C2	29°35'30"	51.65'	100.00'

LEGEND

P.O.B. POINT OF BEGINNING

℄ CENTERLINE

PREPARED BY:

3/14/11

RICHARD C. MAHER, PLS 7564 DATE

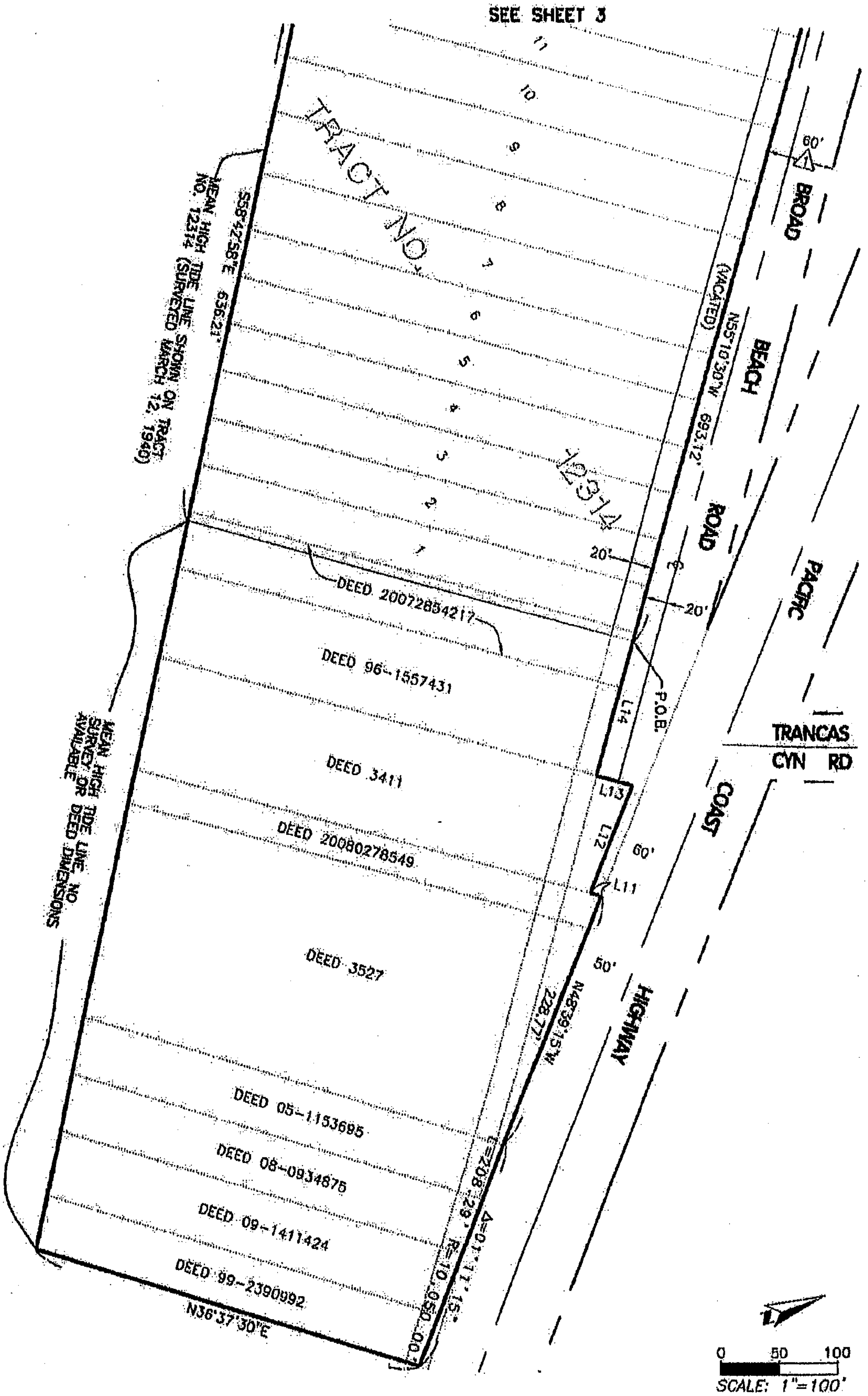
THIS DOCUMENT IS PRELIMINARY UNLESS SIGNED

KDM MERIDIAN, INC. (949)768-0731

03/14/11

EXHIBIT "B"

PLAT TO ACCOMPANY LEGAL DESCRIPTION



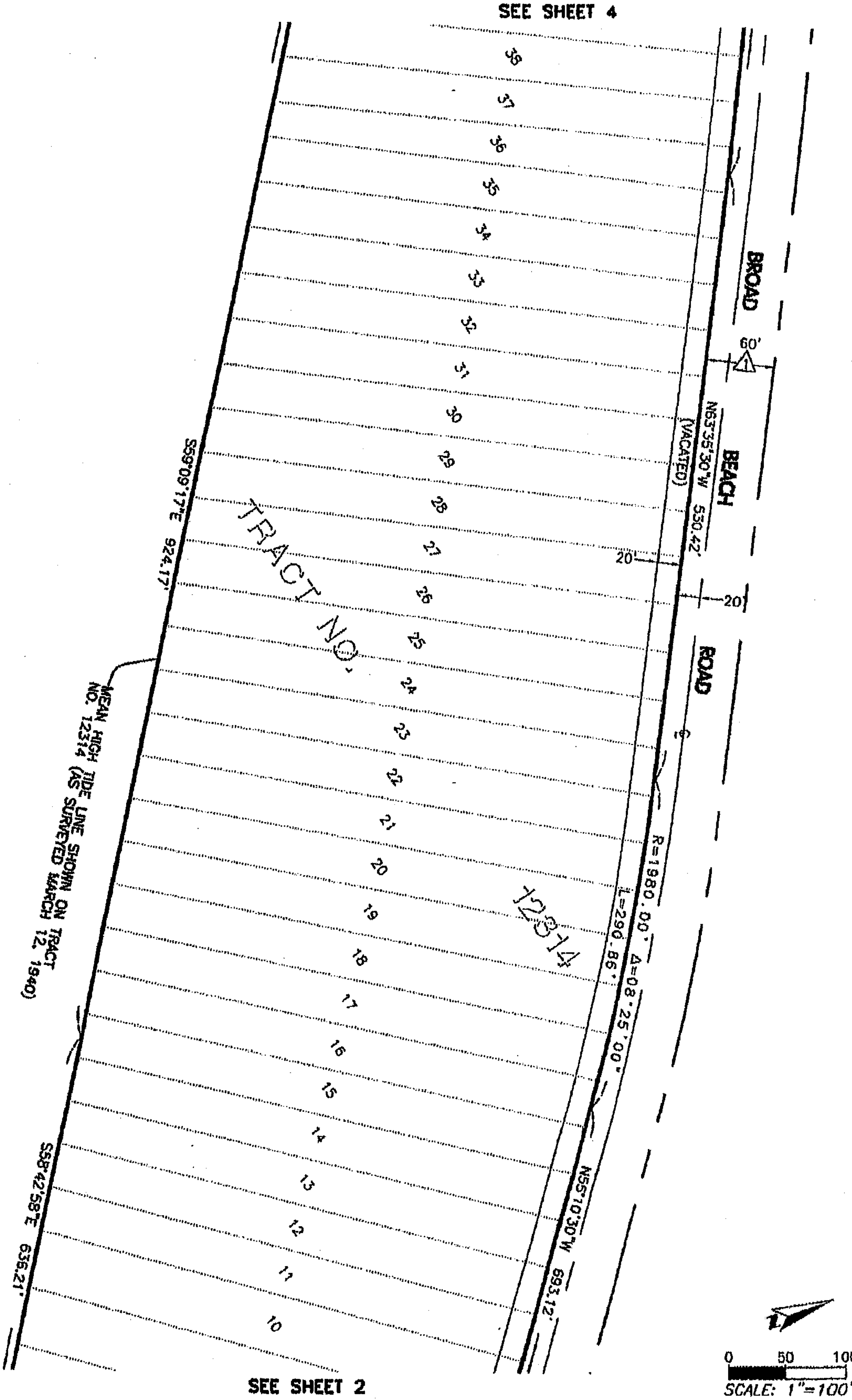
KDM MERIDIAN, INC. (949)768-0731

03/14/11

EXHIBIT "B"

PLAT TO ACCOMPANY LEGAL DESCRIPTION

SEE SHEET 4



SEE SHEET 2

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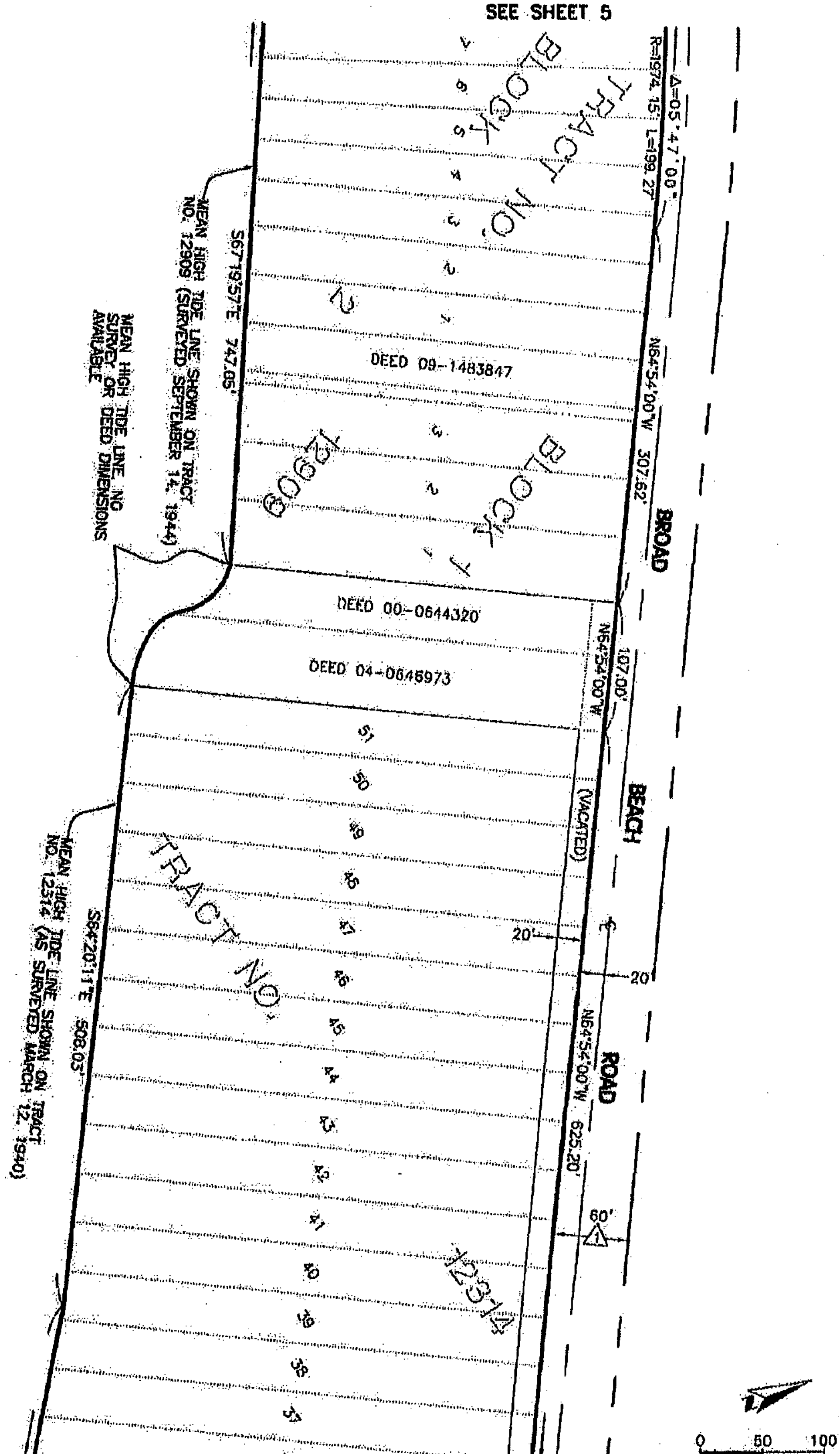
03/14/11

EXHIBIT "B"

PLAT TO ACCOMPANY LEGAL DESCRIPTION

SEE SHEET 5



SEE SHEET 3

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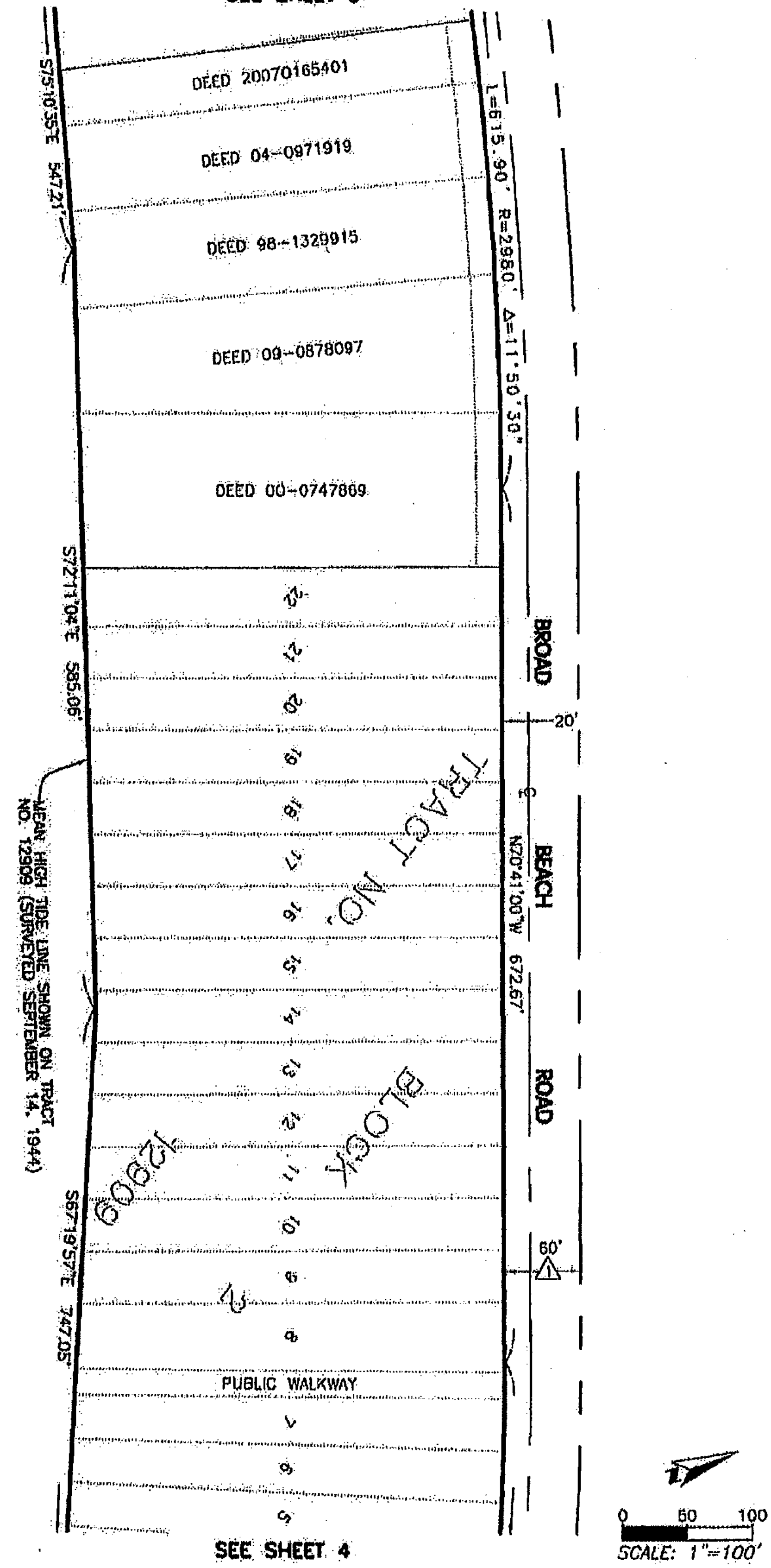
03/14/11

EXHIBIT "B"

PLAT TO ACCOMPANY LEGAL DESCRIPTION

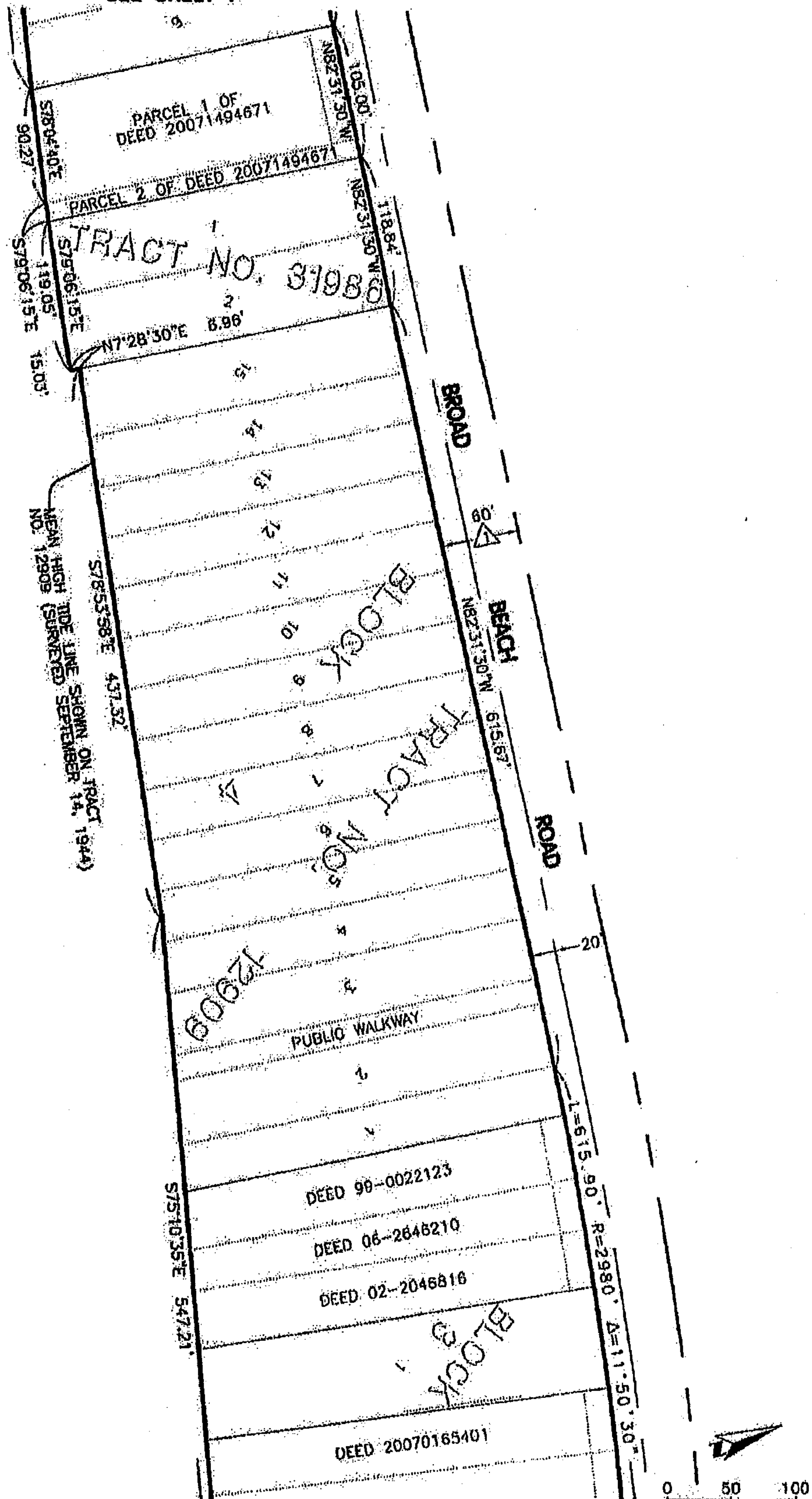
SEE SHEET 6



SEE SHEET 4

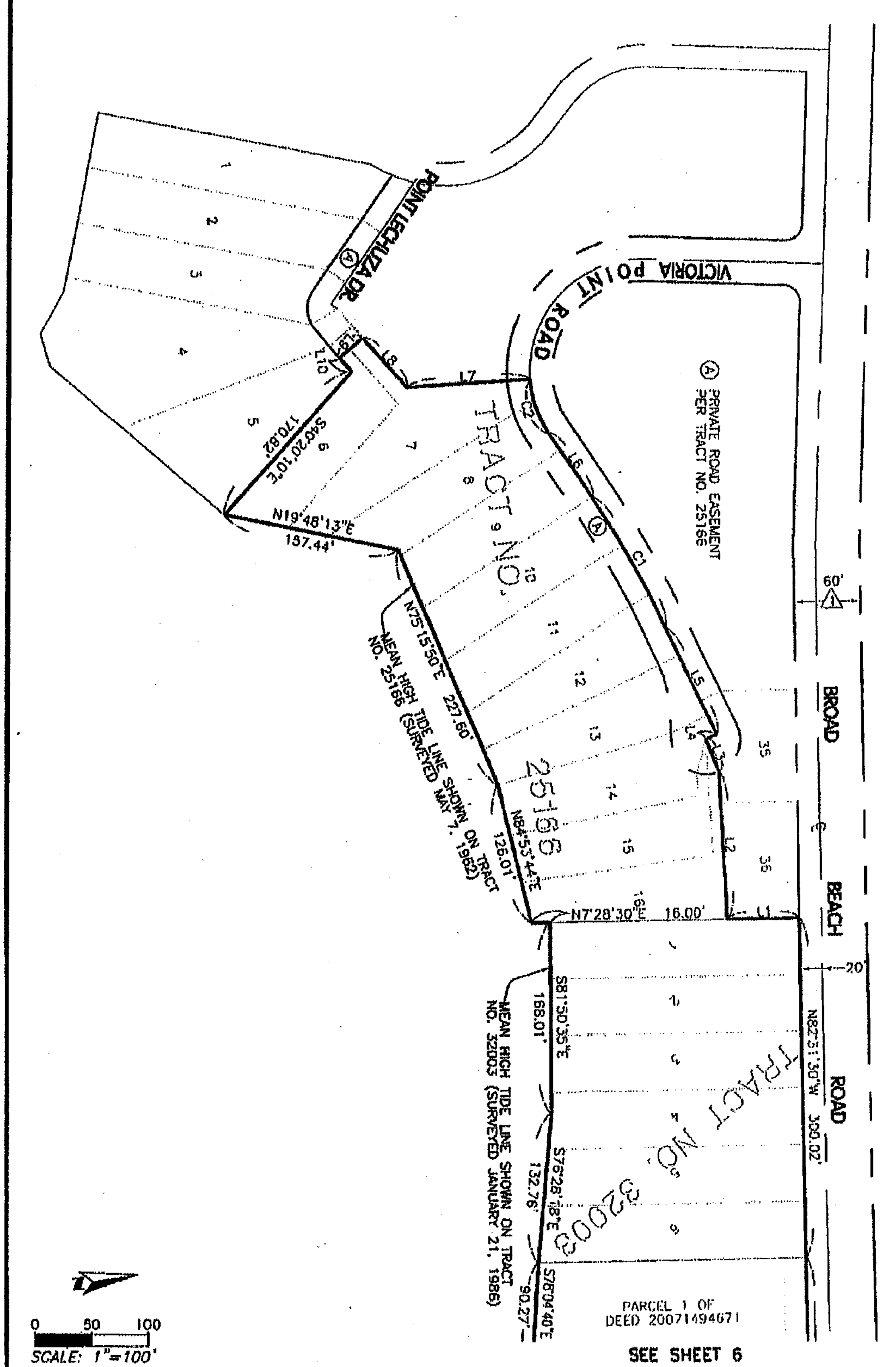
03/14/11	EXHIBIT "B" PLAT TO ACCOMPANY LEGAL DESCRIPTION	SHEET 6 OF 7

SEE SHEET 7



SEE SHEET 5

03/14/11	EXHIBIT "B" PLAT TO ACCOMPANY LEGAL DESCRIPTION	SHEET 7 OF 7



SEE SHEET 6

KDM MERIDIAN, INC. (949)768-0731

EXHIBIT C

Broad Beach Geologic Hazard Abatement District
Budget – June 22, 2017

ENGEO
Expect Excellence

EXHIBIT C

Broad Beach Geologic Hazard Abatement District

Budget – June 22, 2017

ASSUMPTIONS	
Beach Frontage Of Project (excluding Western 22 and Transition 31 parcels) (LF)	3,292
Annual Assessment per Foot of Beach Frontage (current $)	$1,375
Beach Frontage of Western 22 Parcels (LF)	1,256
Annual Assessment per Foot of Beach Frontage of Western 22 Parcels (current $)	$343.75
Beach Frontage of Transitional 31 Parcels (LF)	1,669
Annual Assessment per Foot of Beach Frontage of Transitional 31 Parcels (current $)	$1,031.25
Annual Adjustment in Assessment (estimated)	2.0%
Escalation in Annual Costs (estimated)	2.0%
Investment Earnings (estimated)	0.1%
Frequency of Sand Nourishment (years)	5
Cost of Sand Nourishment (current $)	$18,740,000

ESTIMATED ANNUAL EXPENSES IN 2017	
Administration, Accounting, County Fee, & Insurance	$158,080
Ongoing Backpassing	$0
Legal Fees	$850,000
SAP Managing Fees	$180,000
SAP Monitoring Fees (MHMMP)	$450,000
Dune Habitat Monitoring Program	$218,550
Dune Habitat Remediation Program	$0
Adaptive Management and Monitoring Program	$124,000
Entitlement	$125,000
Biological Monitoring	$115,000
Septic Study	$60,000
State Lands Commission	$50,000
Army Corps Mitigation Reserve	$1,000,000
Lobbyist	$30,000
Beach Nourishment	$18,740,000
Amount Financed	($18,740,000)
Engineering Fee	$331,500
Debt Service	$4,091,965
TOTAL	**$7,784,095**

ESTIMATED ANNUAL EXPENSES IN 2018		
Administration, Accounting, County Fee, & Insurance		$161,242
Ongoing Backpassing		$51,000
Legal Fees		$122,400
SAP Managing Fees		$183,600
SAP Monitoring Fees (MHMMP)		$459,000
Dune Habitat Monitoring Program		$203,550
Dune Habitat Remediation Program		$76,500
Adaptive Management and Monitoring Program		$124,000
State Lands Commission		$50,000
Debt Service		$4,091,965
	TOTAL	**$5,523,257**

ESTIMATED ANNUAL EXPENSES IN 2019		
Administration, Accounting, County Fee & Insurance		$164,466
Ongoing Backpassing		$52,020
Legal Fees		$124,848
SAP Managing Fees		$187,272
SAP Monitoring Fees (MHMMP)		$468,180
Dune Habitat Monitoring Program		$201,050
Dune Habitat Remediation Program		$78,030
State Lands Commission		$50,000
Debt Service		$4,091,965
	TOTAL	**$5,417,831**

EXHIBIT D

Moffatt & Nichol
Coastal Engineering Appendix to the Broad Beach Geologic Hazard Abatement District
Engineer's Report

Broad Beach Restoration Project
Coastal Engineering Appendix
To The Broad Beach
Geologic Hazard Abatement District
Engineers Report
2017 Update

Prepared for:
BROAD BEACH GEOLOGIC HAZARD ABATEMENT DISTRICT

Prepared by:
MOFFATT & NICHOL
3780 Kilroy Airport Way, Suite 600
Long Beach, California 90806

June 2017
M&N File 6935-04

Table of Contents

TABLE OF TABLES

TABLE OF PHOTOS

TABLE OF FIGURES

1. Summary of Project Revisions

The Broad Beach Geologic Hazard Abatement District ("BBGHAD") was formed in September 2011, and the resulting assessment was based on the Engineer's Report prepared by Engeo, Inc. in January 2012. Subsequent to its formation, the BBGHAD has received significant input from state, federal, and regional regulatory agencies, including the California Coastal Commission ("CCC"), the California State Lands Commission ("CSLC"), the Army Corps of Engineers, and their respective consulting agencies and members of the public regarding various aspects of the proposed Broad Beach beach and dune restoration project (Project). To date, the CCC and CSLC have issued required permits (and lease) to the BBGHAD.

Many stakeholders communicated a desire to avoid and minimize impacts to sensitive marine habitats, particularly in the western portion of the Project site. As a result, the BBGHAD authorized the BBGHAD Engineer, Moffatt & Nichol ("M&N"), to develop and analyze a new alternative 4C ("Alternative 4C") which proposes separate sand placements of 300,000 cubic yards each ("Major Nourishments") approximately every five (5) years, a revised sand placement area (limiting West End sand placement at 31380 Broad Beach Rd.), and other Project revisions. Given these substantive modifications to the originally proposed Project, an updated assessment will be required. This report provides an update to the initial Coastal Engineering Appendix to the Engineer's Report, reflecting all the elements of the new Project.

The BBGHAD advocates a significantly narrower sand placement footprint for Alternative 4C (the alternative which constitutes the Project which was permitted by the CCC and CSLC) than that of the Project originally proposed in 2012. The present alternative does not include placing sand material seaward of the 22 western most BBGHAD parcels (19 residences), approximately 1150 feet of shoreline length. This approach differs from the original Project proposed by the BBGHAD, which contemplated an initial placement of 600,000 cubic yards within the entire BBGHAD, from Trancas Creek at the east to Point Lechuza at the west. Under Alternative 4C, no direct placement of nourishment material would occur west of 31380 Broad Beach Road.

The Project goals include restoring a sandy beach over the revised Project length intended to provide the natural shore protection inherent with sand beaches, coupled with the recreational benefits. Ancillary to the shore protection and recreational benefits afforded the BBGHAD, the project will also provide public access benefits and enhanced intertidal habitat value which are necessary elements of the project entitlement.

The Project's rock revetment, seaward of 78 BBGHAD residences from 30760 - 31346 Broad Beach Road, provides a last line of defense against coastal flooding and structural damage to primary structures, including onsite wastewater treatment systems (OWTSs), in the event that the sandy beach erodes away. Both economics and concerns for environmental impacts preclude the placement of sufficient sand volume to provide the necessary protection of primary structures at an acceptable level of risk without the revetment in place.

In an effort to meet the Project goals described above, and do so in accordance with applicable GHAD law, the BBGHAD proposes to implement revised "backpassing" from wider reaches of the beach to narrower reaches of the beach subject to objective triggers, with the frequency not to exceed one time per year. Further, if insufficient sand volume exists for backpassing, the BBGHAD intends to implement additional smaller scale interim renourishments ("Interim Nourishments") to supplement the proposed Major

Nourishments in an effort to maintain sufficient sand beach over the Project length and bury any exposed rock revetment. The frequency and volume of these Interim Nourishments will be determined by additional objective renourishment triggers, and subject to availability of BBGHAD funding.

According to permits received to date, the BBGHAD may use Major Nourishments every 5 years, backpassing according to objective triggers, and Interim Nourishments in every year in which a Major Nourishment will not be occurring to maintain sand on the beach. This amount of direct nourishment exceeds the recent average annual sand loss at Broad Beach of 35,000 cubic yards.

The BBGHAD intends to implement adaptive management techniques to the Project based on detailed, real time monitoring during the Project's duration in accordance with the CCC-directed Science Advisory Panel ("SAP"). The BBGHAD intends to utilize this adaptive management approach throughout the Project lifespan.

The BBGHAD's Coastal Development Permit ("CDP") issued by the CCC (CDP# 4-15-0390) requires a landward relocation of approximately 1,600 linear feet of the eastern portion of the revetment to the line of the existing septic systems with the approximate provision of a minimal 15 foot setback between the seaward limit of the leach fields and the landward edge of the rock revetment. The BBGHAD has analyzed this CCC proposal and further consulted with the CCC and other permitting agencies. The BBGHAD has agreed to relocate the eastern portion of the emergency revetment in accordance with the CDP.

The applicable setback requirement between the wave uprush line and the existing OWTS leach fields constitutes a key factor in the revetment relocation. Based on the BBGHAD's commitment to maintaining beach width in front of the revetment for the permit duration, the risk of wave overtopping and leach field inundation posed by the worst-case scenario has been sufficiently lowered to justify reducing the setback of the revetment pullback's wave uprush line from the existing leach fields. Given the BBGHAD's ultimate desire to transition member properties off septic systems, the increased risk of leach field damage due to increased proximity of the wave uprush line may be acceptable given the anticipated relatively short leach field lifespan of up to 10 years. This pullback also creates sufficient land area seaward of the relocated revetment to more than offset the total amount of area the existing emergency revetment is claimed to encroach (0.85 acres) on public land as asserted by the CSLC according to its January 2010 survey.

This Coastal Engineering Appendix to the BBGHAD Engineers Report is organized as follows:

- Section 2: Problem Description including the basis for the BBGHAD formation;
- Section 3: Project Background including regional setting, existing development on Broad Beach and characteristics of public access;
- Section 4: Coastal Processes which provides a technical description of the geological conditions creating the project need;
- Section 5: Detailed description of the revised project; and
- Section 6: Summary of project benefits for BBGHAD members.

2. Problem Description

Broad Beach is located in the northwest portion of the County of Los Angeles within the City of Malibu, California. The project area is comprised of the shoreline area fronting approximately 114 residences and a beach club spanning approximately from Lechuza Point to Trancas Creek.

2.1 Beach Erosion and Loss of Related Shore Protection

Development along Broad Beach began in the 1930s, consisting of small beach cottages. Given the limited infrastructure available, septic systems and leach fields were typically installed close to the sand dunes seaward of the residences. As construction continued and the site was further developed, most leach fields continued to remain. Most lots were developed by the late 1980s. During this period, the beach remained considerably wider than it is today, especially through the early 1970s. The width of Broad Beach reached a peak in 1970 at a yearly average of 60 feet landward of the present mean high tide line (MHTL). Aerial photographs from 1972 (Photo 2-1) provide a clear illustration of a very large sand volume on the beach. Presently, Broad Beach is a very narrow ribbon of sand visible primarily at low tide, but inundated at high tide (Photo 2-2).

Photo 2-1. 1972 Aerial Photo (California Coastal Records, 2009)

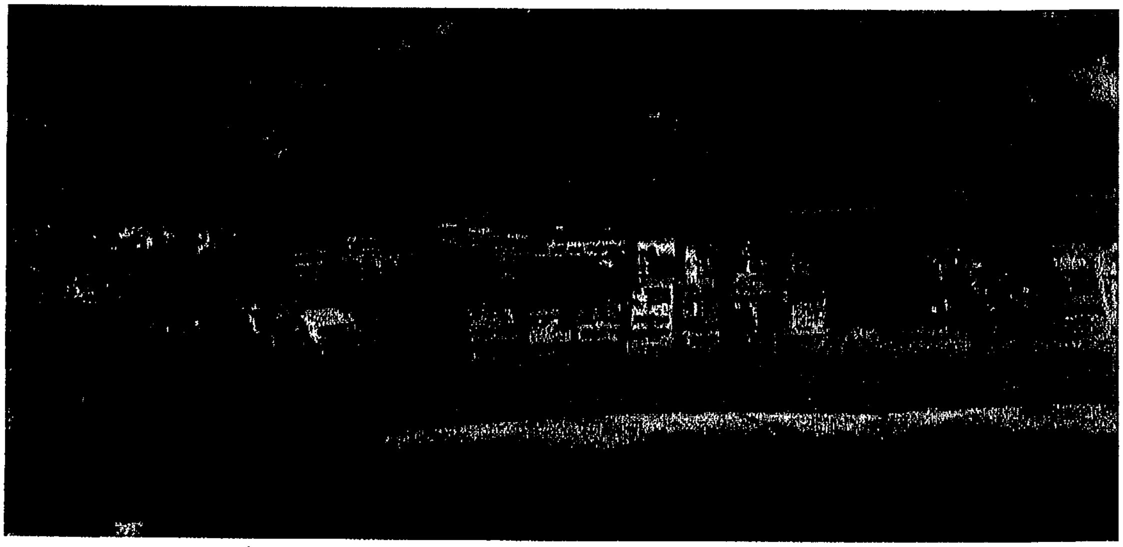


Photo 2-2. 2009 Aerial Photo (California Coastal Records, 2009)

Several recent studies of the coastal region encompassing Broad Beach have identified a trend of continued erosion without any significant recovery in beach width since the early 1970s. The beach is narrowing because of a negative sand balance due either to a reduction in sand supply entering around Lechuza Point, or a change in the magnitude and/or direction of the wave energy that increases the amount of sand leaving the Broad Beach. Between 1974 and 2009, approximately 600,000 cubic yards (cy) of sand was lost at Broad Beach, a majority of which has moved east to Zuma Beach. Studies conclude that this trend of erosion appears to have accelerated in the last two decades. El Niño storm seasons within the last decade have exacerbated the shoreline recession resulting in structural damage and further beach erosion.

The 1997-1998 El Niño storms caused considerable shoreline erosion and related storm wave damage along the California coastline. Many Broad Beach homes were threatened, causing many homeowners to construct temporary sand bag revetments to protect residential structures and leach fields. One residence suffered significant structural damage. During one particularly severe storm in early February 1998, with sand bags already in place, the active beach scarp retreated more than 30 feet in the course of two days.

The 2007/2008 winter season, though milder than the 1997-1998 winter, also resulted in significant retreat of the beach. Many of the homeowners responded with construction of more substantial sand bag revetments, which were authorized through emergency Coastal Development Permits issued by the City of Malibu. Examples of these revetments are shown in Photo 2-3 and Photo 2-4. In addition to these structures, timber protective devices, concrete seawalls, and rock revetments were constructed at various residences along the west end of Broad Beach. Waves and higher tides run up to the foot of historically wide dunes along the east end of Broad Beach. The prognosis for the condition of Broad Beach without beach restoration activities is very poor, given the erosional trends and lack of remaining beach. The visual quality of the beach has been seriously impacted by the unsightly temporary sand bagging and emergency shore protection measures. In addition, opportunities for lateral access and recreation along the beach are severely limited.

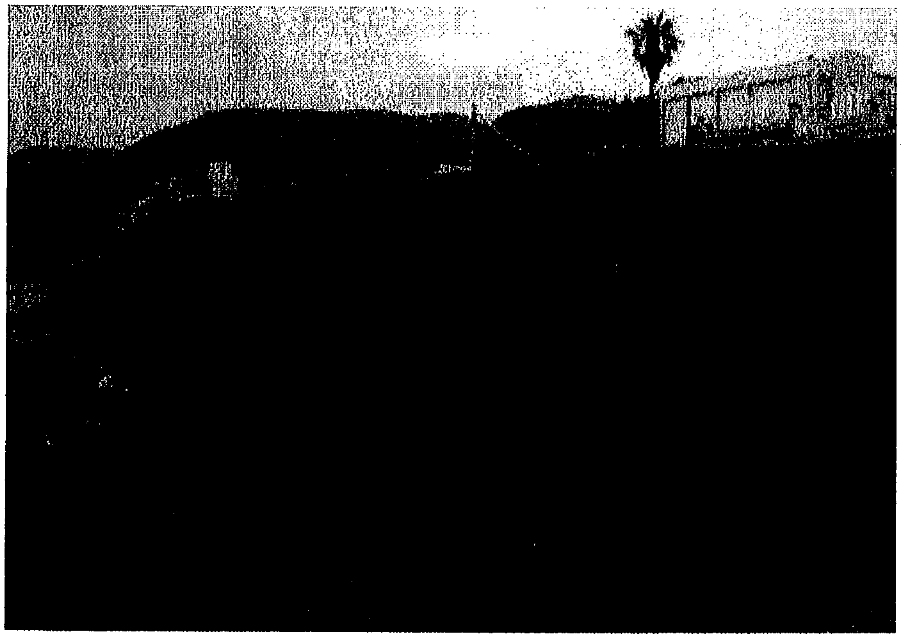


Photo 2-3. Temporary Sandbag Revetment (May 2009)

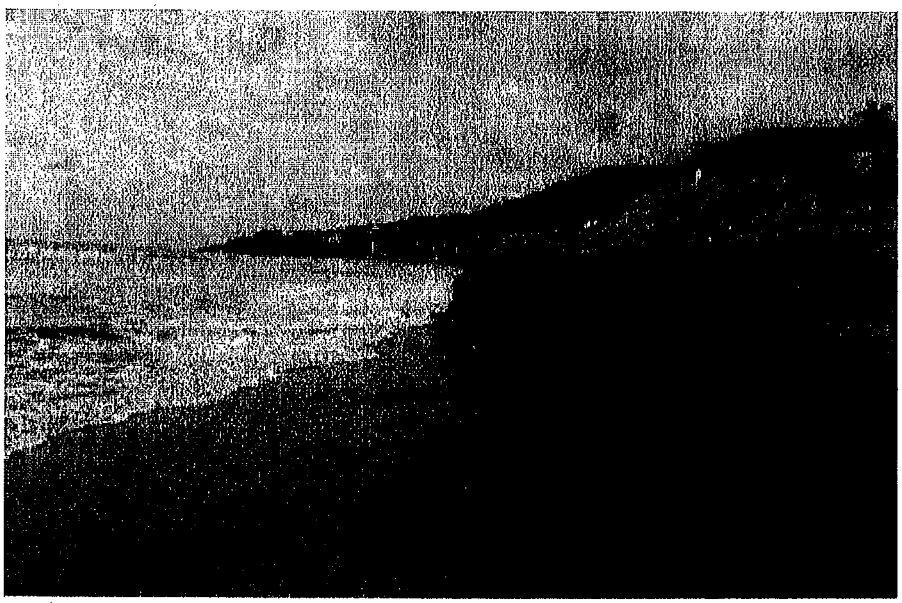


Photo 2-4. Temporary Sandbag Revetment (December 2009)

2.2 Homeowners' Actions

The Trancas Property Owner's Association (TPOA), representing most of the property owners along the Broad Beach shoreline, elected to take action in early 2009 to develop a long term solution to protect against shoreline erosion and reduce the threat to private property. During preparation of the initial planning studies for the restoration of Broad Beach, a large El Niño winter was forecast for the 2009/2010 winter season. In December 2009, there was a significant narrowing of the beach due to storm wave attack resulting in widespread failure of the existing temporary emergency sandbag revetments, especially at the west end of the beach. Photo 2-5 illustrates the eroded shoreline condition near the west end of Broad Beach; Photo 2-6 shows conditions toward the east. It became evident that these temporary structures would not provide sufficient shore protection for the upcoming winter. Acute and significant erosion was proceeding, resulting in significant loss of dune habitat and threatening of residential structures. Undermining and failure of several approved "On-Site Waste Water Treatment Systems" (OSTs) was also imminent without immediate action. Combined with the prediction of moderate to severe El Niño conditions for the upcoming winter, the need for immediate emergency action became apparent. As a result, the TPOA sought and obtained an Emergency Coastal Development Permit (ECDP) to implement an interim shore protection measure to halt the critical erosion until the longer term project is in place.

Photo 2-5. Severe Erosion and Dune Damage at West Broad Beach (January 2010)

Photo 2-6. Temporary Sandbag Revetment Failure and Dune Damage (January 2010)

Under the emergency situation, a temporary rock revetment was considered the minimum action necessary, and the least environmentally damaging alternative. The temporary rock revetment design was developed to stabilize the shoreline against further erosion for the 2009/2010 El Niño season. Other temporary revetment alternatives consisting of geotextile bags were providing a clear demonstration that they could not provide reliable shore protection and could, at best, provide only a false sense of security. In addition to their lack of hydraulic stability, the failed geo-bag (sandbag) system was proving to be a source of debris and litter on the beach.

The TPOA's consultants developed the temporary rock revetment design to provide the minimum necessary protection while allowing for rapid construction. Specific elements of the temporary revetment include:

- Filter fabric to eliminate loss of dune material through voids in the stone matrix;
- Reduced armor size (1/2 to 2 ton) stone to allow for faster construction using readily available, stockpiled stone;
- Reduced revetment volume to allow for faster construction and lateral beach access; and
- Shallower toe elevation for improved constructability.

The TPOA obtained an ECDP and other necessary approvals for the temporary revetment in late 2009 and early 2010. The following photographs show the completed revetment that extends from Trancas Creek for about 4,100 feet west terminating just past the western public access point for Broad Beach. The CDP supersedes the ECDP.

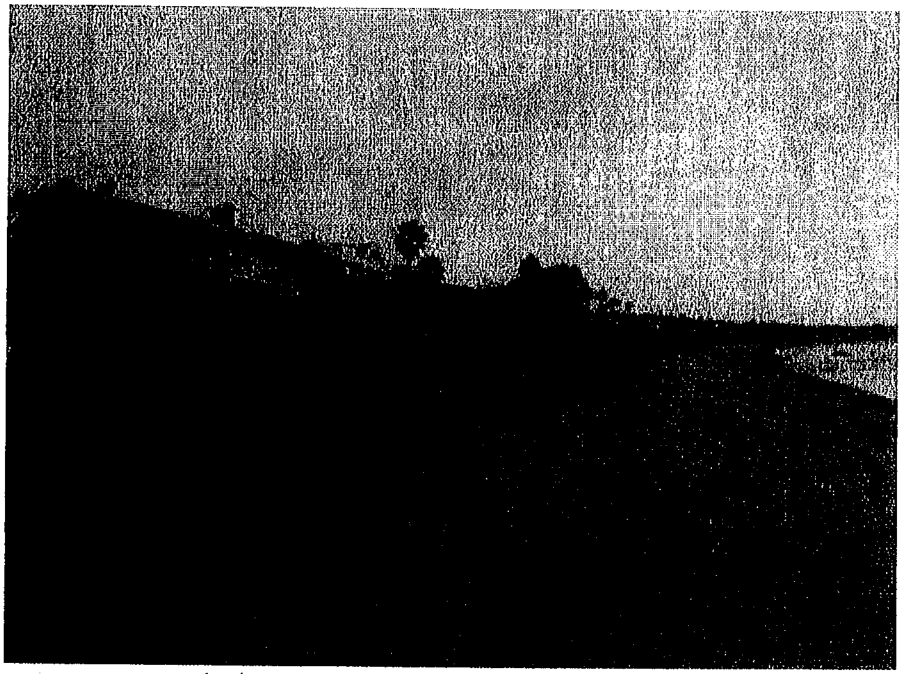


Photo 2-7. Emergency Revetment (February 2010)

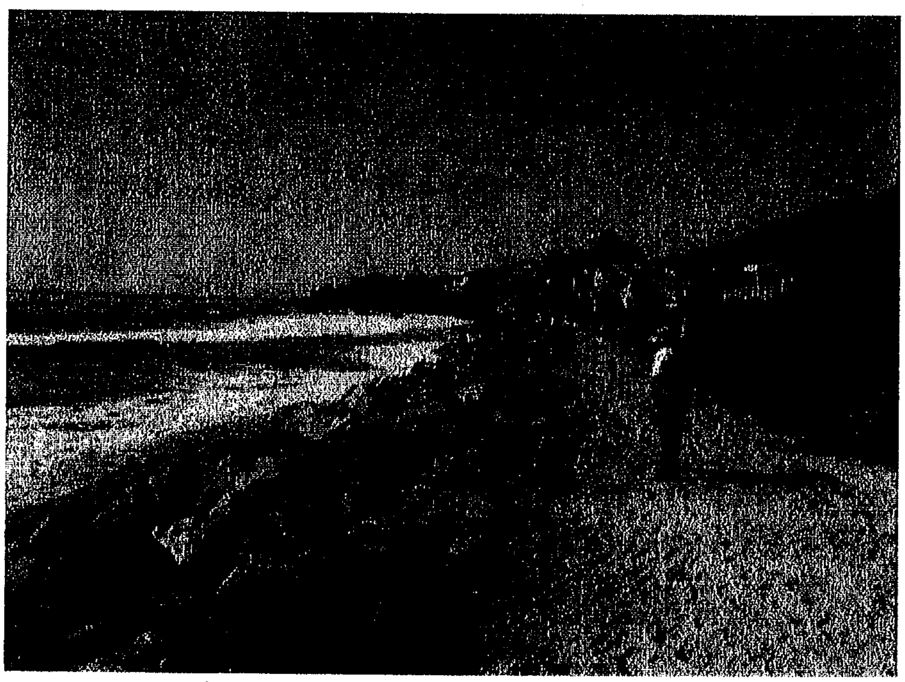


Photo 2-8. Emergency Revetment (February 2010)

3. Project Background

3.1 Regional Coastal Setting

The Southern California coast is a complex, tectonically-active region and is characterized as a collision coast wherein the Pacific Ocean plate subducts on contact with the North American plate. From a geologic time perspective, the process manifests itself in the form of narrow offshore shelves cut by submarine canyons, uplifted by coastal mountains and coastal erosion.

Broad Beach exemplifies a typical Southern California stretch of coastline, comprising a sandy beach backed by coastal bluffs. Broad Beach is located at the western (upcoast) end of a 4 mile long hook-shaped beach between the Point Lechuza and Point Dume as shown in Figure 3-1.

With a total length of just over 1 mile, Broad Beach is bounded by Point Lechuza to the west and Trancas Creek to the east. Zuma Beach and Point Dume State Beach make up the remainder of the hook-shaped beach. This hook-shaped beach is referred to as the Zuma Littoral Subcell (ZLS) throughout this report. Broad Beach and the ZLS lie within the Modern Malibu Littoral Cell (MMLC) shown in Figure 3-2. The MMLC is bounded by Port Hueneme to the north and Marina Del Rey to the south.

Littoral cells are essentially self-contained beach compartments bounded by geographic features such as headlands or submarine canyons that limit the movement of sand between cells. Each compartment consists of sand sources (such as rivers, streams, and coastal bluff erosion), sand sinks (such as coastal dunes and submarine canyons), and beaches which provide pathways for wave-driven sand movement within a littoral cell.

The south-southwest facing MMLC coastline is directly exposed to swells generated in the southern hemisphere. These swells approach Malibu from the southwest, south, and southeast, but the great decay distances typically result in waves of low heights and long periods. Despite sheltering from the Channel Islands, the Broad Beach area is exposed to North Pacific swell through the Santa Barbara Channel. North Pacific generated swells are the most energetic source of waves in the region and the north-westerly approach angle results in a pre-dominant longshore sand transport direction from the west to east in the MMLC.

Due to the wave climate and pre-dominant longshore sand transport direction, Broad Beach and the ZLS depend on sand delivered from upcoast sources, including fluvial discharges from coastal watersheds of the Santa Monica Mountains and erosion of coastal bluffs. Mugu Submarine Canyon captures almost all of the longshore sand supply and represents the upcoast limit of potential sand sources for the ZLS.

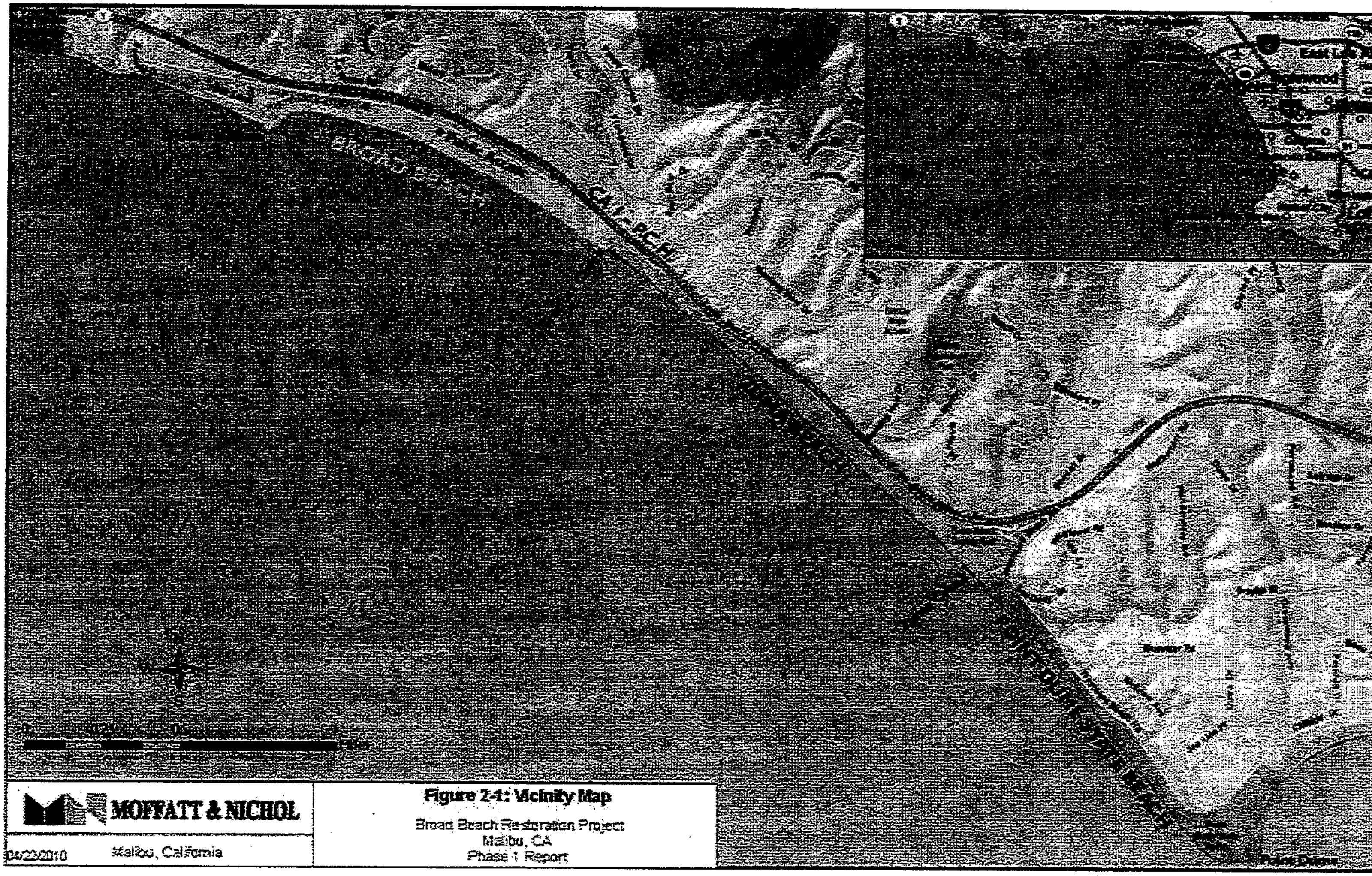


Figure 3-1. Vicinity Map

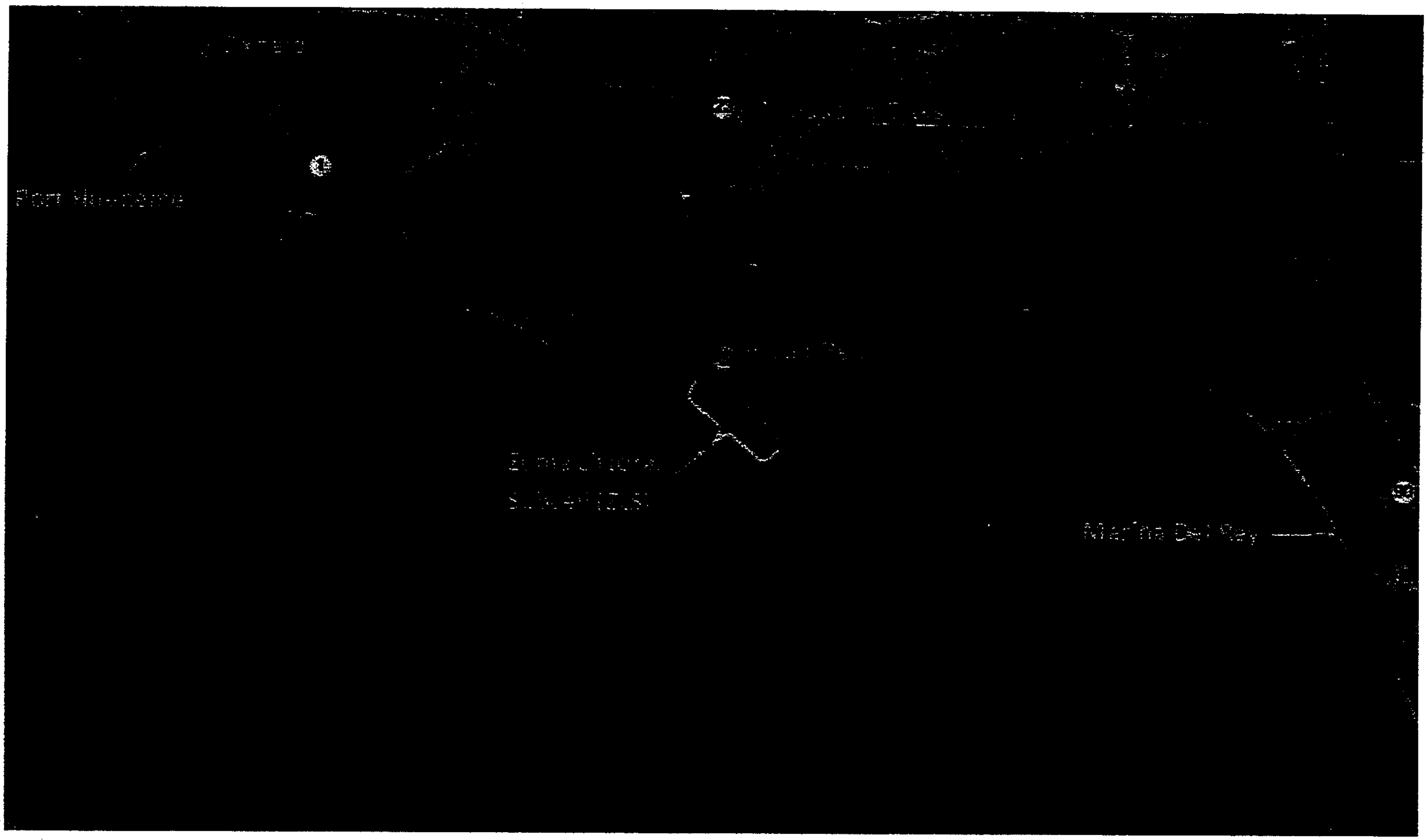


Figure 3-2. Location Map, Modern Malibu Littoral Cell (MMLC)

3.2 Existing Broad Beach Coastal Development

The coastal community of Broad Beach is currently protected by a temporary rock revetment fronting most properties west of the Malibu West Beach Club and east of 31350 Broad Beach Road. Shore protective devices west of this address consist of multiple devices for single or multiple lots. These measures include rock revetments, concrete vertical seawalls, and timber seawalls. Several properties do not have any shore protective structure in place and some are supported by piles which are currently exposed.

3.3 Public Access

Parking is available at Zuma beach immediately to the east, as well as parallel parking along Broad Beach Road. Los Angeles County operates a series of connected public parking lots along the approximately 4 mile stretch of Zuma beach. The westernmost lot, Lot 12, can be used to access Broad Beach on foot after parking. However, much of that lot is occupied by surf camp and other vendor vehicles during summer months. Parallel parking exists along the northern side of Broad Beach Road for almost the entire length of Broad Beach, but these spaces are oriented in a parallel manner, which necessarily limits the capacity of parking along Broad Beach Road.

Vertical access to Broad Beach is provided in two locations at 31344 and 31200 Broad Beach Road via approximately 20' wide parcels owned by Los Angeles County. A component of the emergency revetment project was the improvement of vertical public access paths otherwise operated and maintained by Los Angeles County Department of Beaches and Harbors. A concrete walkway and steps to the beach were constructed over the temporary revetment to maintain vertical access at these locations. These vertical public access paths will be incorporated into the proposed Project.

The eroded shoreline along Broad Beach has significantly limited the recreational beach area and lateral access. There is essentially no dry beach available along most of the beach and during even moderate high tides of 3-4 feet, most of the beach is submerged with waves breaking directly onto the temporary revetment.

In addition to existing physical limitations, lateral access along Broad Beach is affected by a complicated mix of public land, Offers to Dedicate (OTDs) public lateral access easements and private property. Land seaward of the mean high tide line (MHTL) is considered public land. The existing easements along Broad Beach vary from one property to the next according to the contents of the actual recorded grants and, in some areas, may influence lateral access available to the public. Some recorded grants provide for a designated "buffer" seaward from authorized development on a property and the portion available for public access. The buffer typically varies from 5 feet to 50 feet wide along Broad Beach.

4. Coastal Processes

This section describes general coastal processes relevant to the selection and design of solutions to the coastal erosion problems at Broad Beach. These processes include sand movement, tide levels, sea level rise, and wave climate. This section also includes a discussion of the historical shoreline changes at Broad Beach which assist in understanding potential sand loss rates for beach nourishment solutions.

4.1 Water Levels

Water levels are in a constant state of fluctuation subject to short term changes due to tides and storm surge and long term changes associated with sea level rise. Water levels and elevations on land throughout this study are referenced to the Mean Lower Low Water (MLLW) datum. MLLW, as shown in Table 4-1, is approximately 2.8 feet below mean sea level averaged over the most recent tidal epoch. The following sections discuss the processes that influence water levels with a focus on those causing elevated water levels that are most often responsible for coastal-related flooding and damage.

4.1.1 Tides

The tides at Broad Beach are classified as mixed semidiurnal (two unequal highs and lows per day). Tide characteristics from the Los Angeles tide gage nearest the project site are shown in Table 4-1. These are based on the most recent (1983-2001) tidal epoch.

Table 4-1. Water Levels at Broad Beach, Based on LA Outer Harbor Tide Station (NOAA/NOS, 2008)

Water Level	Elevation to MLLW Vertical Datum
Extreme High (Observed January 27, 1983)	+7.8 feet
Mean Higher High Water (MHHW)	+5.5 feet
Mean High Water (MHW)	+4.7 feet
Mean Sea Level (MSL), 1983-2001 Epoch	+2.8 feet
National Geodetic Vertical Datum -1929 (NGVD29)	+2.6 feet
Mean Low Water (MLW)	+0.9 feet
North American Vertical Datum – 1988 (NAVD88)	+0.2 feet
Mean Lower Low Water (MLLW)	0.0 feet
Extreme Low (Observed December 17, 1933)	-2.7 feet

4.1.2 Storm Effects

In Southern California, the highest tides of the year typically occur in the winter months. Wave overtopping and wave-related coastal damage often occurs when an extremely high tide coincides with high storm waves. A statistical analysis of extreme water elevations was developed based on recorded annual extreme high water elevations obtained from the National Ocean Service for the outer Los Angeles Harbor reference tide station. Water elevation records were available from 1923 to 2002. Table 4-2 shows the annual extreme high water elevation versus recurrence interval. The extreme still water levels combined with sea level rise projections provide the basis for estimating a design water depth for coastal engineering analyses.

Table 4-2. Extreme Water Levels versus Recurrence Interval

Recurrence Interval (Years)	Extreme Still Water Elevation (Feet, MLLW)
5	7.4
10	7.6
25	7.7
50	7.9
100	8.0

4.1.3 Long Term Sea Level Rise

Sea levels are projected to rise in coming decades as a result of increased global temperatures associated with climate change. When discussing sea level rise (SLR) (and when reviewing SLR projections), it is important to distinguish the differences between global and local SLR rates. Global SLR rates discount local effects such as tectonics (i.e., land uplift/subsidence), water temperatures, and wind stress patterns that can act to subdue or amplify the global SLR rates. Local (or relative) SLR refers to the observed changes in sea level relative to the shoreline in a specific region and takes into account these local factors.

A myriad of planning and policy-level guidance on SLR has been released by international, federal, and state entities. These guidance documents are generally based on research and publications generated from the scientific community. The most applicable guidance to the proposed project is the California Coastal Commission SLR Policy Guidance (CCC 2015). This guidance document is based on the National Research Council (NRC) 2012 study, which provided local SLR projections for the west coast of the United States.

Guidance related to SLR evolves as new science is released and confirmed. The most relevant science and guidance from the international, federal, and state levels at the time of this report is summarized in this section.

California Coastal Commission SLR Policy Guidance (CCC 2015)

The document provides step-by-step guidance on how to address SLR in new and updated Local Coastal Programs (LCPs) and Coastal Development Permits (CDPs) according to the policies of the California Coastal Act. The steps provided in the guidance are as follows:

- Establish the projected SLR range for the Project.
- Determine how impacts from SLR may constrain the Project site.
- Determine how the Project may impact coastal resources, considering the influence of SLR.
- Identify alternatives to avoid resource impacts and minimize risks.
- Finalize the Project design and submit CDP application.

The document states that best available science should be utilized when conducting project-level or regional vulnerability assessments. The NRC 2012 study detailed below is considered the best available science for the region at the time of this report. The CCC SLR Policy Guidance document remains the most current document and was unanimously adopted by the CCC in August 2015.

National Research Council (NRC 2012)

The NRC is a group of scientists and research organizations that act as an advisory group for government agencies. The NRC study projections indicate a 0.5-foot increase in relative SLR by 2030 and a 3.1-foot increase by 2100 (Table 4-1) in the Los Angeles region. The confidence level in the projections, indicated by the uncertainty values, increases with the projection year as does the difference between the low and high projections.

Table 4-3: SLR Projections for Los Angeles Region (NRC 2012)

Time Horizon (feet)	Low End of Range (feet)	Projection (feet)	High End of Range (feet)
2013	0.00	0.00	0.00
2030	0.15	0.50	1.00
2050	0.40	0.90	2.00
2100	1.40	3.10	5.50

The potential impacts of sea-level rise on the beach and dune system are difficult to quantify with any certainty. If the beach were treated as a simple sloped structure with a 30:1 (horizontal to vertical) slope, then the waterline could move landward by as much as 30 feet or more by the year 2050. However, since the beach is dynamic, it has the ability to respond to water level changes and the results are rarely linear. In addition, current dunes at Broad Beach further complicate the situation. It is clear, however, that sea-level rise places the landside structures at additional and increasing levels of risk, and should be considered a fundamental part of any design solution.

Sea level rise primarily causes beaches and shorelines to retreat landward. In general, on beaches which have a slope of 10:1 (horizontal: vertical), each inch of sea level rise would result in 10 inches of beach retreat (loss of beach width). For beaches which have a slope of 30:1, each inch of sea level rise would result in 30 inches of beach retreat, i.e. the flatter beaches would experience a greater amount of shoreline retreat. Based on the projected sea level rise numbers above and assuming no modifications to the shoreline, future beach retreat along LA area beaches was estimated for the range of scenarios (lower rate to highest rate); these values are shown in Table 4-4.

Table 4-4. Beach Retreat Due to Sea Level Rise Rates at Los Angeles Area Beaches

Beach Slopes Horizontal : Vertical	Horizontal Beach Retreat From 2010 Shoreline (Lower Rate to Highest Rate, Feet)	
	Year 2030	Year 2050
10:1 (Steeper)	1 to 5	1 to 11
20:1	1 to 11	3 to 21
30:1 (Flatter)	2 to 13	3 to 27

At Broad Beach, the foreshore beach slopes (area seaward of scarp face or edge of dune) are close to 30:1. The distance between the existing mean-high-tide line (MHW) and the back beach (edge of dune or edge of scarp face) is close to zero along much of the Broad Beach shoreline, i.e. the high tide line is already at the back beach line. Based on this and the sea level rise numbers in the table above, the scarp face would move almost 30 feet landward by 2050 solely due to sea level rise if no back beach shore protection was first created.

4.2 Waves

Wave climate is the primary force for generating alongshore sediment transport and is, therefore, a critical element of any study aiming to evaluate and quantify sediment transport rates and associated change in beach sand volume and shoreline position. This section provides a summary of the wave climate along Broad Beach and discusses the wave data sources used to evaluate the regional and local historic beach performance.

4.2.1 Wave Exposure

The southern exposure of Malibu and the proximity of the Channel Islands offshore limit the direction from which potentially destructive storm waves can impinge upon the area. The islands serve to create wave exposure windows, dissipating and reflecting wave energy and thereby modifying the wave conditions along the mainland shoreline. Upcoast shoreline features also serve to create wave exposure windows and refract waves before they reach the Malibu area. Wave exposure windows for the Malibu shoreline are illustrated Figure 4-1.

In general, there are three main types of waves which occur along the southern California coast and which could occur through the Malibu wave exposure windows: North Pacific swell, southern swell, and seas generated locally. The North Pacific swell events are the most significant source of extreme waves in the region. The Broad Beach area is exposed to North Pacific swell through the Santa Barbara Channel. Swell from winter storms in the southern hemisphere reach California during the months of May through October. These swells approach Malibu from the southwest, south, and southeast, but are partially blocked by the Channel Islands. Additionally, the great decay distances result in waves of low heights and long periods.

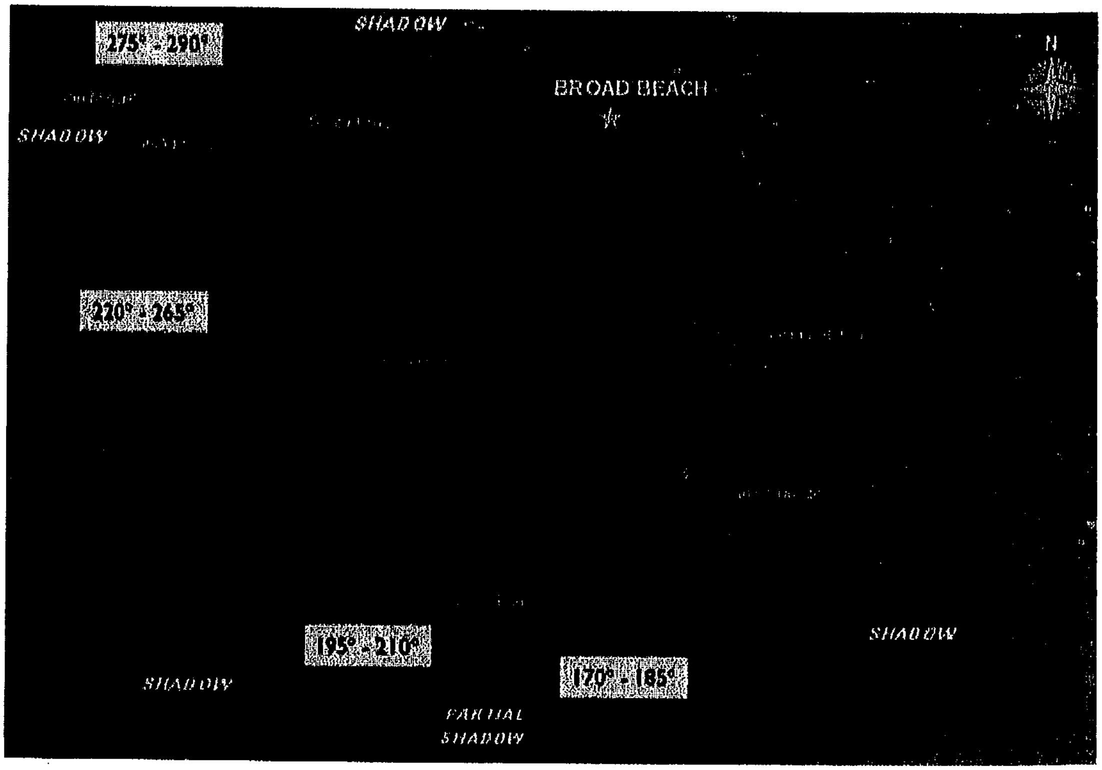


Figure 4-1. Wave Exposure Windows at Broad Beach

Wave direction affects how the sand moves along the shoreline. Waves that travel through the Santa Barbara Channel to Malibu from the west (North Pacific swell waves) are especially effective at moving sand alongshore from west to east. South swells arriving nearly straight onto the shore of Malibu are more effective at moving sand in a cross-shore direction, either offshore to deeper water or onshore from deeper water.

Scripps Institution of Oceanography operates and maintains ocean monitoring stations through the Coastal Data Information Program (CDIP). The closest CDIP monitoring station to Broad Beach is CDIP Buoy 102 offshore of Point Dume in 365 meter water depth. The significant wave heights and wave periods based on wave direction at this buoy are shown in Figure 4-2 and Figure 4-3, respectively.

Flick and O'Reilly (2008) studied wave exposure at Broad Beach based on the closest NOAA wave buoy (Buoy 46025, approximately 33 miles northwest of Catalina Island). Their study presented wave transformation coefficients that can determine the relative wave height at Broad Beach as a function of the offshore wave period and direction of wave travel. The study showed that Broad Beach is vulnerable to a broad swath of southerly and south-westerly approaching waves (from 170 degrees to about 240 degrees) where the refraction coefficients are close to 1 (high) or ever larger in a few instances. Wave exposure falls off rapidly for essentially all wave periods for approach directions north of about 260 degrees.

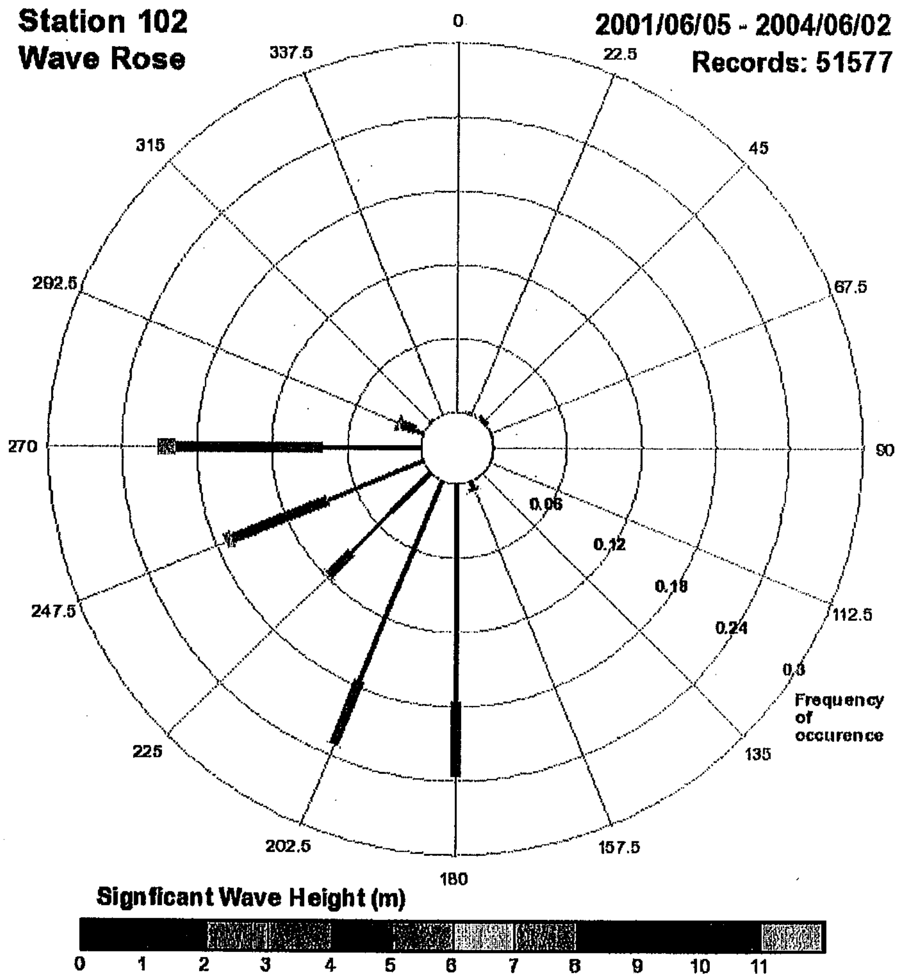


Figure 4-2. Significant Wave Height (Wave Rose) Offshore of Point Dume (CDIP, 2010)

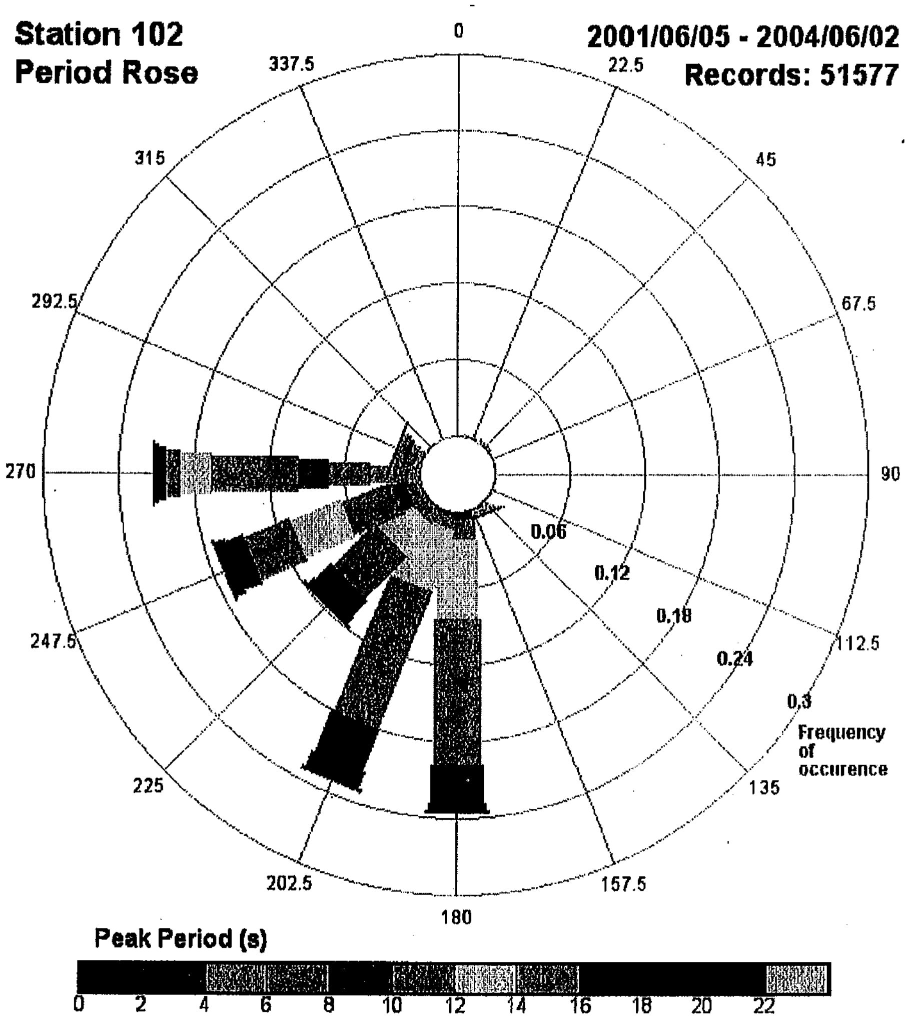


Figure 4-3. Peak Wave Period (Period Rose) Offshore of Point Dume (CDIP, 2010)

4.2.2 Extreme Waves

Flick and O'Reilly (2008) also noted a number of extraordinary large wave events in the NOAA wave buoy records. These include the maximum measured wave height of about 26 feet on January 19, 1988 and several other wave-storm events exceeding 20 feet. Based on the NOAA wave buoy data from 1982 to 2001, the mean monthly wave heights varied by only 50% or so (range of 3.3 to 5 feet), whereas the seasonal variation in the extreme wave heights varied by a factor of four (from ~6.5 feet in July to 26 feet in January). Extreme wave heights drop substantially to about 13 feet by April and May each year, and stay that way on average through October.

El Niño conditions cause increased storminess and have historically increased the frequency and intensity of higher local waves, increasing the severity of beach erosion and coastal flooding. El Niño conditions occur on average every 2-5 years, and usually last about 12 months. Strong El Niños occur less frequently and come in many different varieties, with no two ever the same (Flick, 2009). Whether and how waves from any particular El Niño winter affect southern California is largely determined by the tracks storms take as they travel from their generation regions in the western Pacific off Asia toward the Eastern Pacific and North America. These tracks are determined by the path of the mid-latitude jet stream, which depends on the relative positions of the North Pacific high pressure system and the Aleutian low. About two-thirds of El Niños are associated with strong winter storm activity in southern California. (Flick, 2009)

El Niños have occurred most recently in 1982-83, 1986-87, 1991-92, 1994-95 and 1997-98, 2002-03, 2006-2007, 2009-10, and 2015-16. The 1997-98 was the strongest on record and it developed more rapidly than any El Niño of the past 40 years. The 1982-83 El Niño is also considered to be one of the most major recent storm events and caused considerable damage along the coast of California. The most recent 2015-16 El Niño exhibited winter wave energy that equaled or exceeded measured historical maxima across the US West Coast (Barnard, et al, 2017).

4.2.3 Design Wave for Shoreline Structures

The critical design case for shallow water shoreline structures is when wave breaking takes place in front of the structure (CEM 2003). The maximum height of waves which can break upon a shoreline structure is limited by the water depth fronting the structure. The water depth varies over time based on tide levels and will increase with future sea level rise. This analysis is based on this maximum depth-limited breaking wave height, which is defined as the "design wave height". Deep water waves exceeding the design wave height will break offshore and dissipate much of their energy before they reach the shoreline structure.

A statistical evaluation of extreme high water elevations was developed based on the recorded annual extreme high water elevations obtained from the NOAA/NOS LA Outer Harbor reference tide station (Table 4-5). The effect of future relative sea level rise must also be included in the determination of the design water depth.

The extreme scour elevation is also required to determine the design water depth at the toe of any potential shore protection device. Due to the variability of the sand elevations from seasonal changes and storm events, it is difficult to predict with great accuracy the depth of scour. But, based on experience in Southern California, a scour depth of 0 feet MLLW is appropriate to reduce undermining. Therefore, scour depth at the toe of the structure is estimated to reach the mean lower low water elevation.

Based on the probabilistic extreme high water elevations, sea level rise, and assumed scour elevation, a range of potential design water depths was calculated, i.e. the low end of the range was calculated based on a 5-year recurrence high water elevation with a low rate sea level rise. A high end estimate was calculated based on a 100-year recurrence high water elevation with the highest rate sea level rise.

Factors other than water depth affecting the maximum wave height include the incident wave period and nearshore beach slope. Longer period waves will result in higher design breaking waves (USACE 1984). A design wave period, T, of 16 seconds was selected as the design period to obtain the subject breaking wave height, as this represents the average of the most frequently occurring storm-generated swell in this region. Based on available beach profiles in the Broad Beach area, nearshore slopes ranged from approximately 25:1 (horizontal:vertical) to 30:1.

Estimates of breaking wave heights were developed using methods described in the *Shore Protection Manual* (USACE 1984) and *Coastal Engineering Manual* (USACE 2003), for the range of potential design water depths. The results (range of potential breaking wave heights) are shown in Table 4-5.

Table 4-5. Broad Beach Breaking Wave Heights Range

Probabilistic Still Water Elevation Based on LA Harbor Tide Gage Statistics		Probabilistic Sea Level Rise by 2050 (Feet)		Design Water Level (Feet, MLLW)	Maximum Scour Depth (Feet, MLLW)	Design Water Depth (Feet)	Breaking Wave Height (Feet)
Recurrence Interval (Years)	Elevation (Feet, MLLW)						
5	7.4	Low Rate	0.2	7.6	0.0	7.6	8.3
25	7.7	Likely High Rate	1.0	8.7	0.0	8.7	9.6
100	8.0	Highest Rate	4.3	12.3	0.0	12.3	13.3

These large breaking wave heights are indicative of the relatively steep nearshore profile fronting Broad Beach and the significant estimates of future sea level rise.

4.3 Sediment Transport Rate Analysis

The preceding sections summarize existing and available data used to describe historic and recent shoreline locations, wave climate and its role in shoreline dynamics, water level variations, and projected future sea level rise that can affect wave conditions and shoreline location. This section draws upon this information and other data sources to conduct detailed analysis to quantify historic shoreline changes and sediment transport rates which constitute the key parameters in the development of a long-term shoreline restoration project.

The average Broad Beach sand volume changes relative to an arbitrary base are presented in Figure 4-4 through Figure 4-6, and include the associated trendlines. Figure 4-4 shows the full 63-year data record. Figure 4-5 illustrates the trend over the past 41 years during which the beach was generally erosive. Figure 4-6 shows the most recent five-year time period. By reviewing the changes in volumes, as well as rates of change in volume, trends in the sediment transport regime can be assessed. The earliest switch from rise to fall in the volume of the littoral sediment lens appears to have occurred in the late 1960s and 1970s. The peak was followed by a progressive loss until the present.

The trendlines indicate the following:

- Figure 4-5: 1968-2009, 41 years of data - 20,000 cubic yards per year (cyy) loss.
- Figure 4-6: 2004-2009, 5 years of data - 35,000 cyy loss.

These trends indicate a continuing pattern of erosion since the 1970s and acceleration of erosional trends.

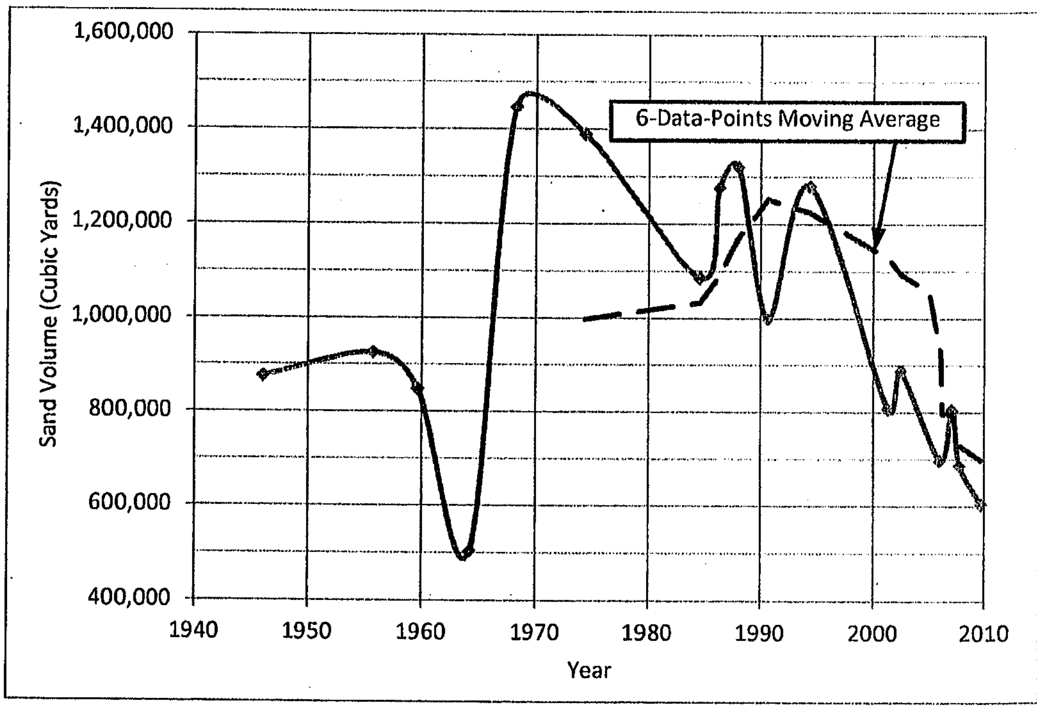


Figure 4-4. Volumetric Changes, 1946-2009

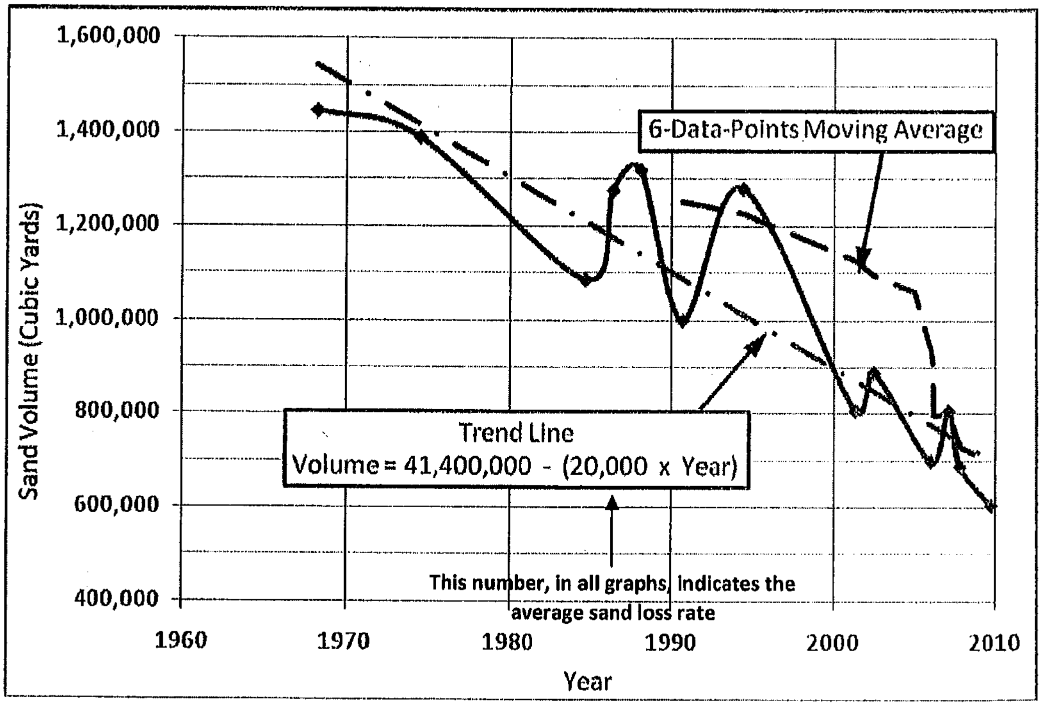


Figure 4-5. Volumetric Changes, 1968-2009

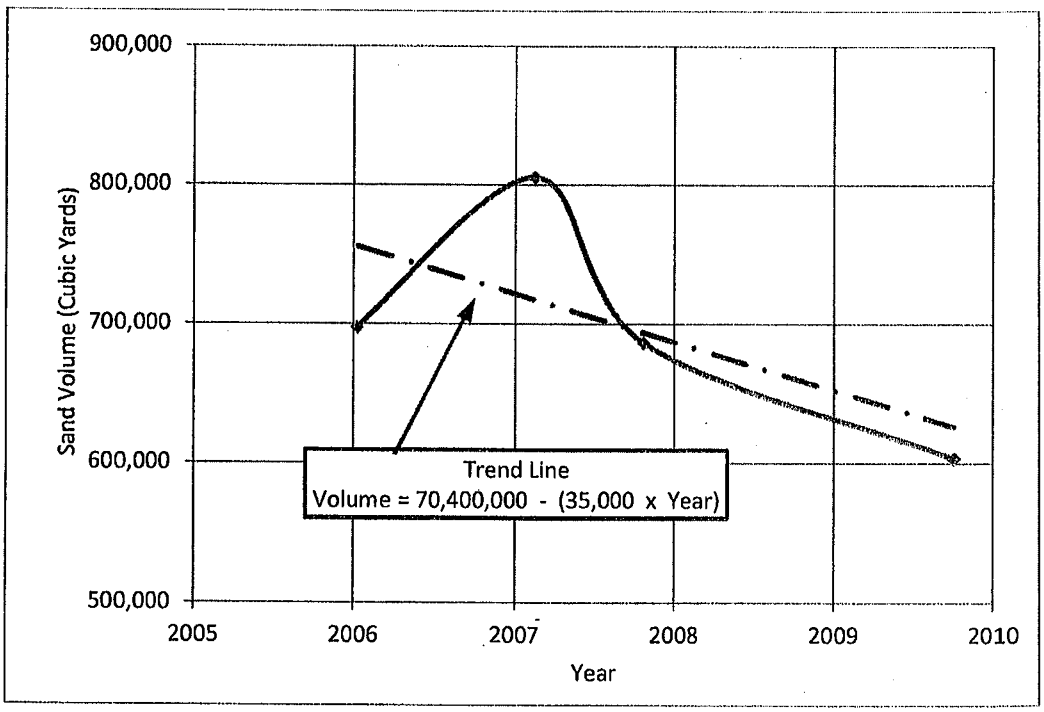


Figure 4-6. Volumetric Changes, 2006-2009

Since 2009, Coastal Frontiers Corporation has conducted seasonal beach profile measurements for the BBGHAD. Additional beach profile data is also available from the US Army Corps of Engineers dating back to 2002. This data is very useful to understand changes in shoreline position and sand volume over time. In its 2016 Annual Report (Coastal Frontiers Corporation, 2017), Coastal Frontiers found that from Spring 2002 to Spring 2014, the average annual sand loss rate along Broad Beach was 29,000 cy per year. This generally corroborates the preceding estimate of a 35,000 cubic yard loss per year from 2006-09. It is important to note that beach profiles measured since 2010 represent Broad Beach shoreline behavior with the rock revetment in place. Any calculation of the natural background erosion rate subsequent to revetment construction may be underestimated as erosion is limited once the sand has eroded back to the revetment.

Another important finding from the beach profile measurements and related shoreline volume analysis is that during the period from Spring 2014 to Fall 2016, Broad Beach gained 57,000 cy per year. This finding provides evidence that even on an eroding shoreline, there can be shorter term periods of significant sand accretion.

4.4 Summary

Sand loss estimates were developed based on the sum of two components of sand loss: (1) the current "natural" loss rate projected into the future, and (2) the additional loss due to beach widening (beach nourishment).

Between 1974 and 2009, Broad Beach lost approximately 600,000 cy of sand. On average, the shoreline moved 65 feet further inland. The greatest recession occurred close to Lechuza Point and tapered off toward Trancas Creek. Once the sand budget turned negative in 1974, the Broad Beach loss rate increased thereafter by approximately 900 cy per year. By 2009, the natural sand loss rate was about 35,000 cubic yards per year at Broad Beach.

The Broad Beach shoreline is retreating because of a negative sand balance. Sea level rise accounts for less than 5 percent of the imbalance. An analysis of wave measurements and historical beach and shoreface data also argues against the notion of a decades-long transport of hundreds of thousands of cubic yards offshore. Rather, the sand imbalance is due to a positive longshore sand transport gradient. The analysis indicates the gradient is either due to a reduction in sand supply entering around Lechuza Point or a change in the alongshore component of wave energy that increases the amount leaving near Trancas Creek.

5. Description of Revised Proposed Project

5.1 Project Objectives

The Broad Beach Restoration Project seeks to design, permit, and implement a long-term shoreline restoration program that provides erosion control and property protection, with ancillary benefits of improved recreation and public access opportunities, aesthetics, and environmental stewardship. The need for this project results from a decades-long trend of shoreline erosion that has recently accelerated and reached a critical point in which residential structures and onsite wastewater treatment systems are threatened by coastal erosion and flooding. The major objectives of the proposed Project include:

- Protect existing homes, structures and other improvements including septic systems along Broad Beach from coastal erosion;
- Create and maintain a wide sandy beach backed by a restored dune system similar to that which historically occurred along this reach of coastline; and
- Develop a cost-effective long-term plan for maintaining shore protection along Broad Beach.

5.2 Key Elements of Project

The Project, as proposed, would implement a shoreline protection plan along Broad Beach for at least 20 years, consisting of:

- Beach nourishment to recreate both a dry sand beach and a restored dune system;
- At least 20 years of dune restoration;
- At least 20 years of sand backpassing designed to prolong nourishment; and
- Permitting the partially relocated 2010 rock revetment as a permanent structure buried under both the beach nourishment and dune.

The BBGHAD proposes to conduct all of the following in accordance with the CDP:

1. Major Nourishments every five (5) years - in year 0 and placement 2 would occur approximately 5 years later. The performance of the Project would be monitored regularly, assessed every 5 years, modified as required and upon permitting by all agencies.

2. Subject to permitting, another two Major Nourishments, also of quarry sand, would be conducted in approximately year 10 and approximately year 15 as needed in accordance with objective triggers.

3. The BBGHAD also proposes to conduct smaller-scale backpassing from wider reaches of the beach to narrower reaches of the beach according to certain objective triggers, with the frequency not expected to exceed one time per year. In the event that insufficient sand volume exists for backpassing, the BBGHAD intends to complete Interim Nourishments to maintain a sufficient sand beach over the Project length to bury any exposed rock revetment and maintain a minimum width of sandy beach. The frequency and volume of such nourishments will be determined by the CDP in accordance with additional objective renourishment triggers.

5.3 Revised Beach and Dune Design

The total Project area of new dunes, beach berm and beach face would cover up to 24.3 acres. The height of the proposed sand dunes would be typical of the existing dunes at the east end of the Project, approximately 20 feet higher than MLLW. MLLW is the average of the lower of the two low tides that occur each day. The top of the relocated emergency rock revetment would be buried beneath at least 2 and up to 5 feet of sand. Depending on location, the profile of the new dry sand beach berm would be roughly 12 to 15 feet above MLLW or existing low tide winter sand levels. The new post-construction dry sand beach berm would extend seaward of the dunes by approximately 60 to 75 feet. At its widest point, the combined new beach and dune system would extend for 240 feet seaward from approximately the top of the relocated revetment to the surf zone on the face of the beach berm.

Due to predicted impacts, the proposed Project under Alternative 4C has been revised not only to avoid direct placement of beach and dune building material on sensitive habitat including rocky intertidal habitat, rocky outcrops, offshore reef, and associated surf grass habitat, but also, at the CCC's request, to avoid the "boulder field" centered seaward of approximately 31418 Broad Beach Road. As a result, direct placement of beach and dune building material will end at 31380 Broad Beach Road. A plan view of Alternative 4C placement is provided in Figure 5-1 and typical sections shown in Figure 5-2.

In accordance with the CDP, the revised dune restoration plan includes construction of foredunes and establishment of appropriate native foredune vegetation. Foredunes will be created on top of, landward, and seaward of the existing or relocated rock revetment. Overall dune design will consist of a dune system with individual dunes hillocks of similar size, shape, and distribution as reference dunes at Ormond Beach, Pt. Mugu Naval Air Station, McGrath State Beach, and San Buenaventura State Beach.

The new foredune habitat will be seeded with native species typical of southern foredune plant communities. In general, the seed mix will contain low-growing perennial southern foredune plants such as red sand verbena, pink sand verbena, beach saltbush, beach evening primrose, and beach morning glory. The dune restoration area will be constructed to form hillocks shaped to resemble naturally occurring dune features and will use a combination of sand from Broad Beach and approved imported sand from the sources listed in Section 5.4. Three distinct sand treatment areas will be implemented using different combinations of sand from these sources, which are described below.

Dune hillocks will be placed on the top, seaward slope, and landward slope of the dune footprint and in general, the hillocks will be circular in shape. The diameter, shape, and height of the dune hillocks were designed based on the range of sizes and heights found at Ormond Beach. The dune hillocks will be placed in a semi-random configuration and re-arranged slightly to facilitate the vertical private and public access paths, as well as storm drain outfalls. The height of the overall dune restoration area will range from 12 to 20.5 feet NAVD88, reflecting the typical heights of the remnant dunes that currently exist at Broad Beach.

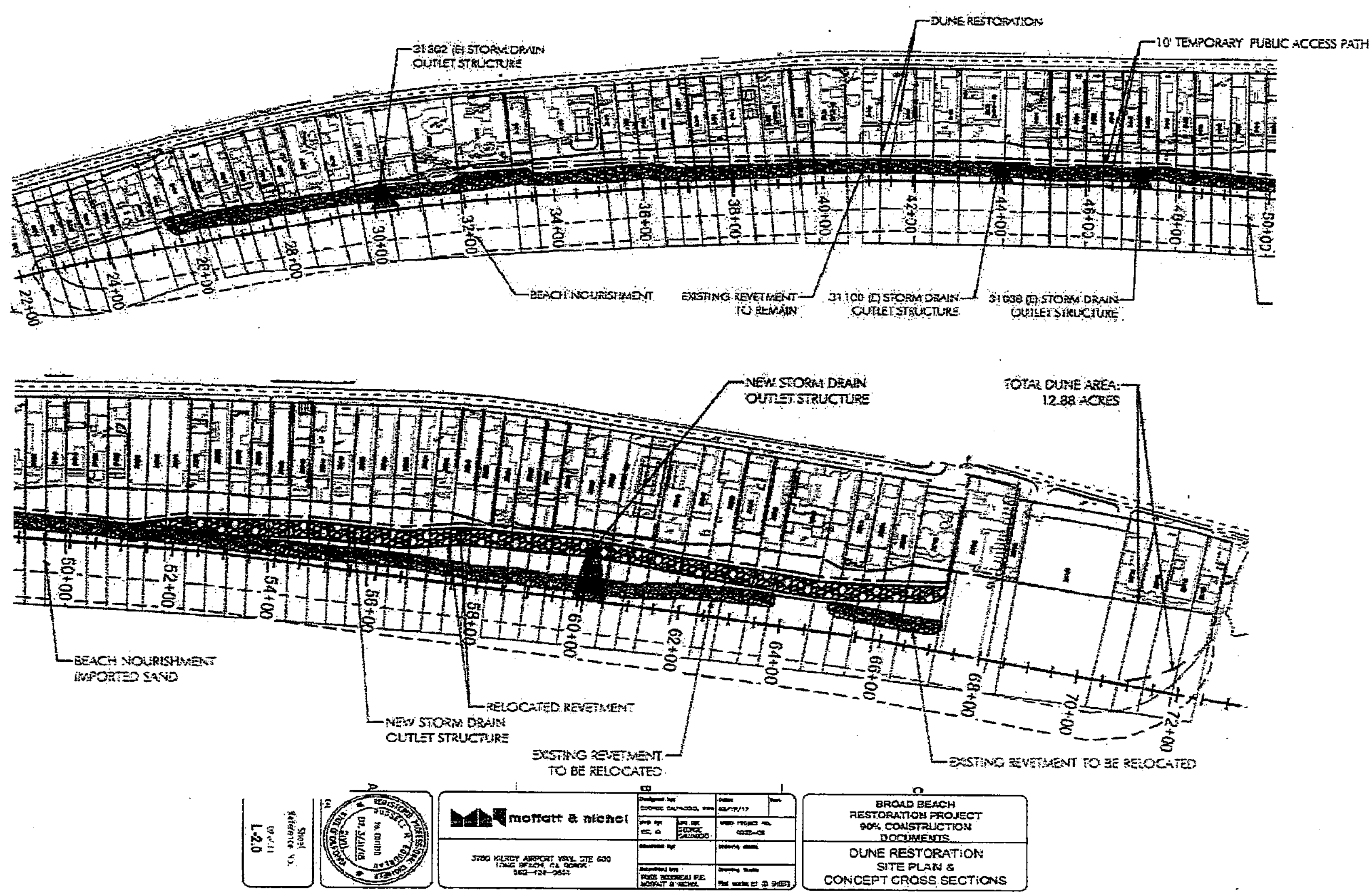


Figure 5-1. Plan View of Alternative 4C

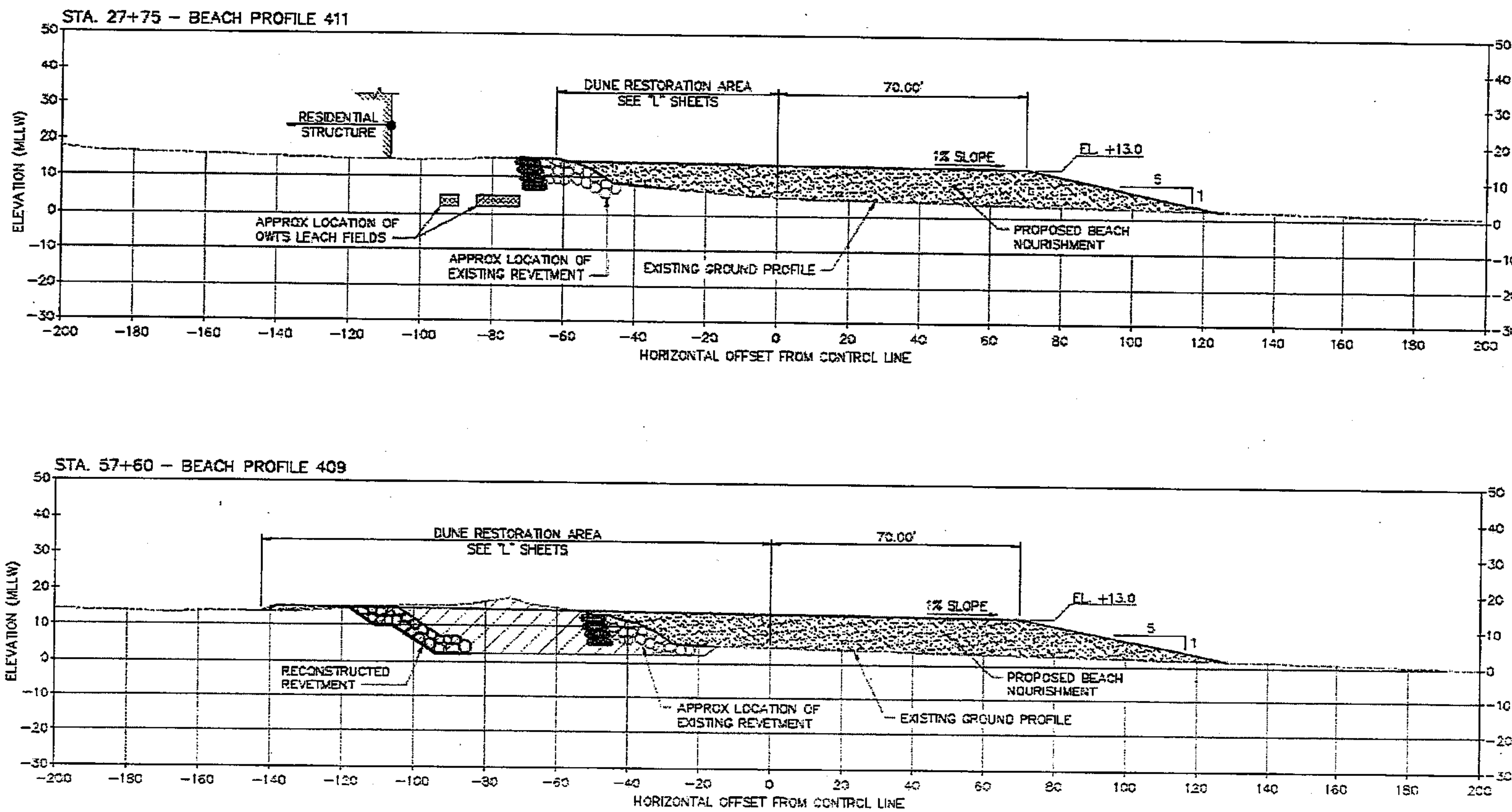


Figure 5-2. Alternative 4C, Typical Sections

The BBGHAD proposes to place dune hillocks throughout the dune restoration area except for the following locations:

- In front of the stormwater outfalls where the dune field will be blown out from annual winter storm water discharge;
- Along the private access paths, the Beach Club access path, and the vertical public access paths;
- Within 10 feet of the CCC development stringline where septic fields occur.

It is expected that the dune hillocks will be reshaped quickly by Aeolian processes and will develop more natural shapes that conform to the prevailing wind direction.

Three sand treatments will be used within the dune restoration area. The three sand treatments will allow for the comparison of the effects of sand grain size on vegetation establishment and Aeolian transport of sand related to dune and beach rebuilding. The sand treatments will be composed of the native Broad Beach sand and the imported sand. The three sand treatments will include: 100% Broad Beach sand, 100% imported sand, and a 2-foot-thick cap of Broad Beach sand over the imported sand. These sand treatments will allow for the comparison of the effects of sand grain size on vegetation establishment and Aeolian transport of sand as it relates to the ability of the dunes to rebuild by natural processes. The performance of all three sand treatments will be compared to the reference sites as part of the monitoring program.

The designated dune habitat is located between 30708 Pacific Coast Highway and 31380 Broad Beach Road and would fully mitigate impacts to existing dunes at a 3:1 ratio. The BBGHAD proposes the footprint east of 31380 Broad Beach Road and ending at 31020 Broad Beach Road to have a combined dune and dry sand beach berm approximately 125 feet wide and a beach berm face constructed at a 5:1 slope extending seaward for an additional approximate distance of 60 feet where it intersects the existing beach. The BBGHAD proposes the beach berm in this area at 12 feet above MLLW. Between 30980 Broad Beach Road and 30760 Broad Beach Road, where the revetment relocation landward will occur in accordance with CCC direction, the dune area is proposed to widen and range from approximately 75 feet in width to approximately 150 feet. The CCC-required dune footprint will result in the landward toe of the dune extending up to 50 feet landward of the relocated revetment and the seaward toe up to 100 feet seaward of the revetment with dune elevations at roughly 15 to 20 feet above existing MLLW to cover the existing revetment. The BBGHAD designed the proposed dune area to replicate the existing dunes at the eastern end and former dunes at the site. Figure 5-3 shows representative dune areas in cross section.

In areas where the constructed dune abuts existing dune on the landward side, the BBGHAD's proposal would meet or exceed the elevation of the existing dune to protect existing dune habitat. In areas where the constructed dune abuts lower lying non-dune private properties, to meet the CCC required dune footprint the BBGHAD proposes the dune to slope landward for 10 to 30 feet in generally a 5:1 slope (although slope varies based on existing topography). In the locations within the Project area with no rock revetment, the BBGHAD contemplates that the constructed dune system would likely be lower and tapered to integrate with conditions at each adjacent property.

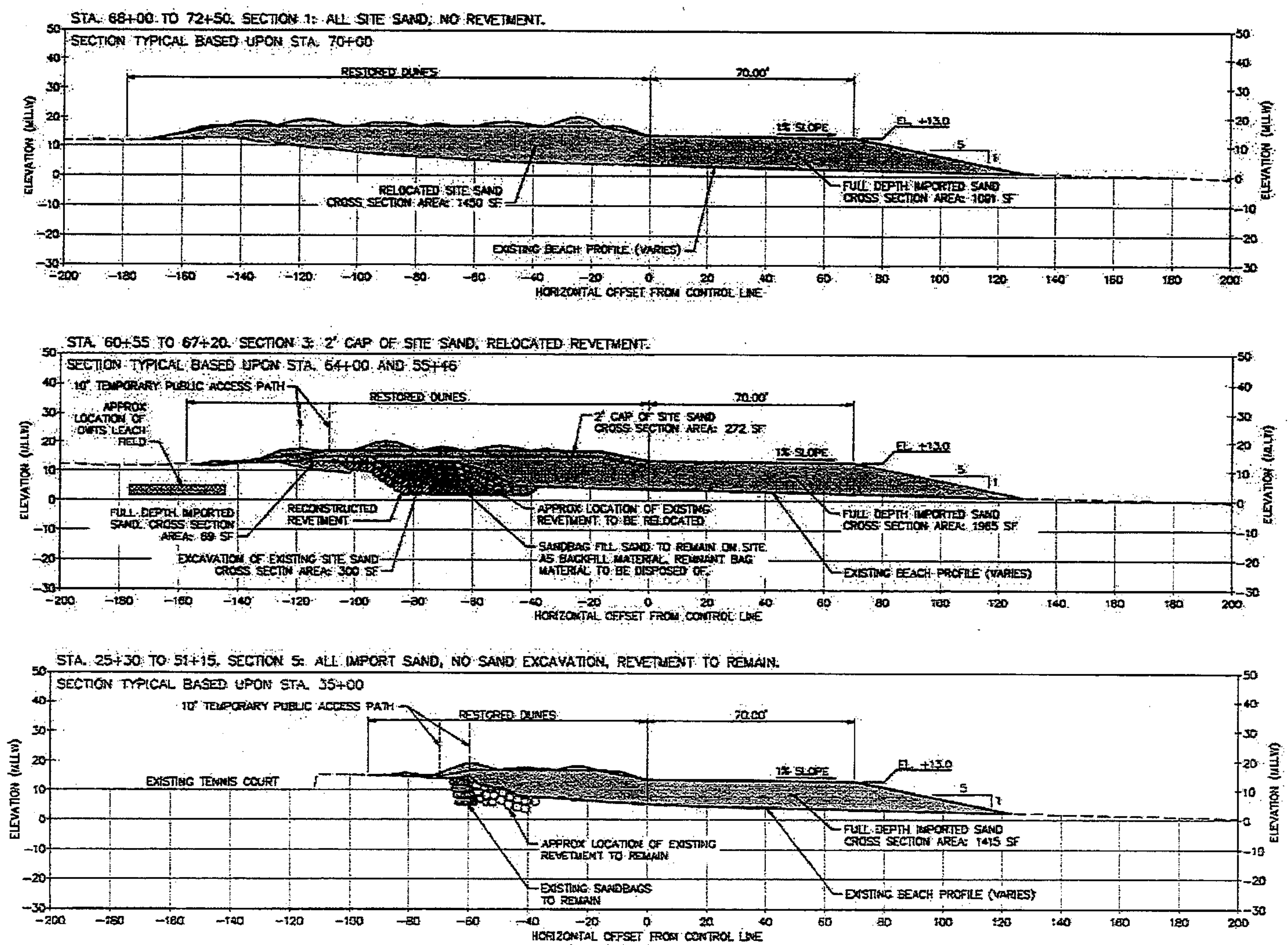


Figure 5-3. Cross Section of Dune Habitat Areas showing Three Treatment Areas

Source: WRA 2017

5.4 Sand Sources for Beach Nourishment and Dune Restoration

The primary sand sources for the proposed Project are inland quarry material, suitable for dune and beach-quality sand (see Figure 5-4). Since 2010, the BBGHAD has expended significant time and effort investigating offshore, harbor-area, and former river bed sand sources for beach nourishment and dune building material. For example, with oversight from the primary permitting authorities, the BBGHAD conducted extensive benthic, chemistry, grain size, and other analyses on sand approximately 40-50 feet below the water surface approximately one third mile offshore Dockweiler State Beach in Los Angeles. Subsequently, the BBGHAD discovered that the City of Los Angeles owned the subject offshore sand and was not interested in selling this sand to the BBGHAD. The BBGHAD also investigated other sand in Ventura Harbor and in Calleguas Creek in Ventura County, but these sands could not meet chemical compatibility requirements with native Broad Beach material or other governmental agency requirements.

In short, all of the alternative sand sources were discovered to either have material which was deemed incompatible with the Project's goals, presented insurmountable hurdles in securing authorization or, in the example of the offshore Trancas site, was located in a marine protected area with restrictions on allowable offshore activities.

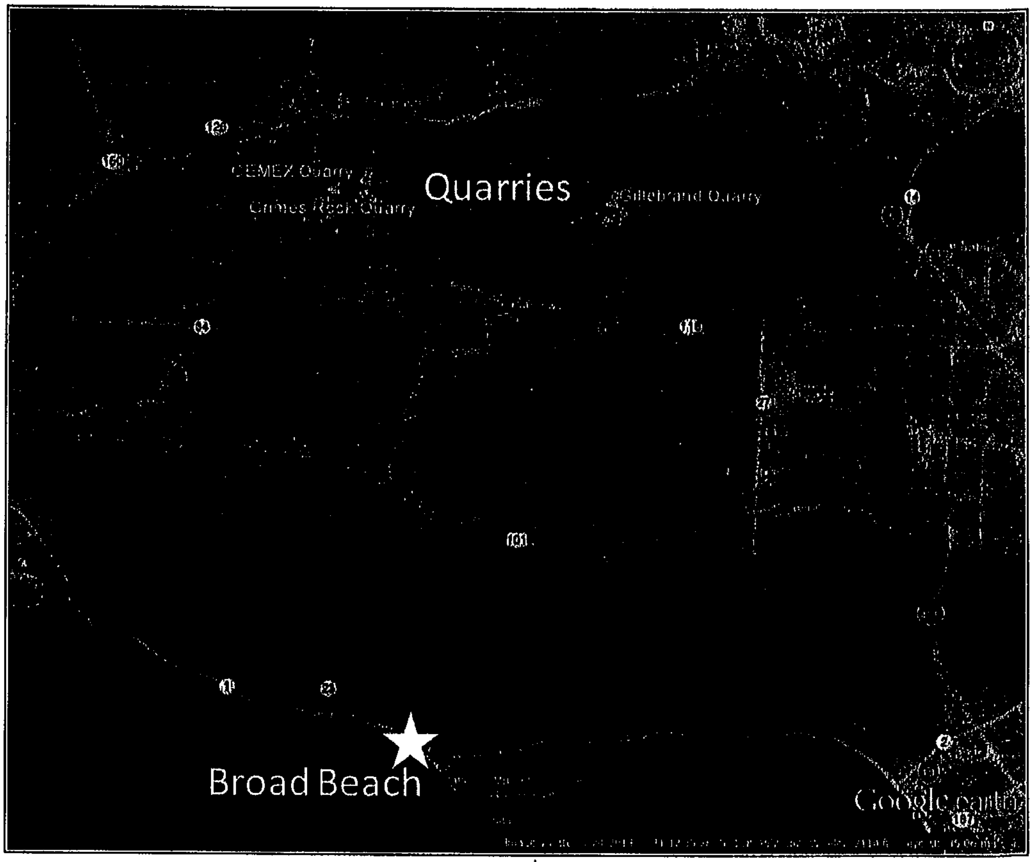


Figure 5-4. Broad Beach Restoration Project - Sand Source Area

Sand for beach nourishment should be of medium-grain size, coarser than the fine-medium grain size present on the existing beach in order to better resist erosion and maximize dry beach width.

The proposed source for medium-grain sand are private local commercial quarries (CEMEX, Grimes Rock, and P.W. Gillibrand, collectively, "Local Inland Sources") in the Moorpark/Simi area of the Simi Valley, 20-25 miles north of the Project site by air and 40-45 miles north of the Project site by truck. The BBGHAD proposes to transport the quarry material via truck to the Broad Beach site and distribute it by heavy equipment including large (40-ton capacity) off-road trucks, bulldozers and scrapers to create the final beach and dune templates. Front-end loaders are proposed to be used to move sand as needed. The stockpiled materials originate from a sandstone geologic formation believed to be a former seabed, i.e. marine sedimentary rock. Two quarries, Grimes Rock and CEMEX, possess the capacity to provide the quantity of sand required for the Project (300,000 cubic yards of material per Major Nourishment). A third quarry, P.W. Gillibrand, can supplement the Project if the other quarries cannot meet the capacity needed to serve the Project, and can significantly expand operations, if needed, to potentially supply the Project with all of the material. The material is continually excavated, stockpiled, and removed as part of ongoing quarry and aggregate sales operations.

Figure 5-5 shows the geologic setting of the quarries and indicates that sandstone is the sediment source. Large strata of sandstone are typically formed in pre-historic marine environments, suggesting that these materials are former seabed. Sand sieve test results show the material to be 92.5% sand and 7.5% silts and clays, which is generally compatible with the beach. The median diameter of the quarry material is larger than the current beach, but this fact is an attribute for beach nourishment material as the fill material will reside on the beach longer and prolong benefits. The San Diego Association of Governments used beach fill material that was more coarse than the native material in both 2001 and 2012 to maximize the San Diego area project's life, and to also maximize the width of the new beach berm. Coarser sand resides higher on the beach profile and typically results in a wider recreational beach berm area than finer sand.

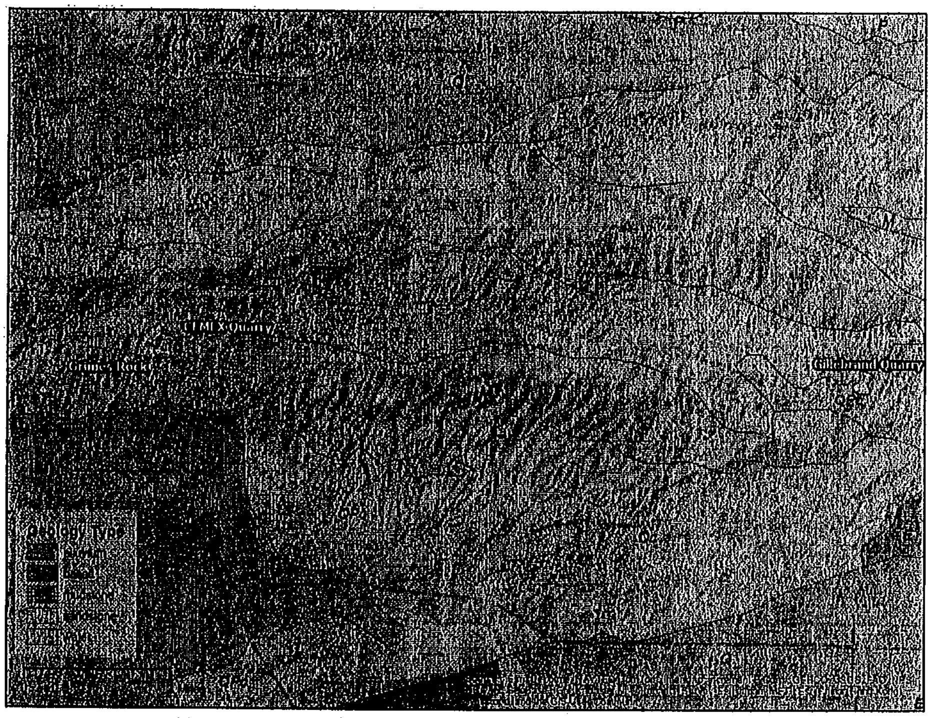


Figure 5-5. Geology Strata of the Quarries as Sandstone
Note: The Blue Polygon Represents the Sandstone Deposit.

In response to CCC requirements, the median grain size or d50 of the quarry material selected for beach and dune creation will be between 0.24 mm and 0.60 mm.

Photographs of the existing sand stockpiles at each quarry are provided below. These stockpiles are continually reworked, turned over, removed, and replaced for commercial purposes, so the sand is well mixed and homogeneous throughout the piles.

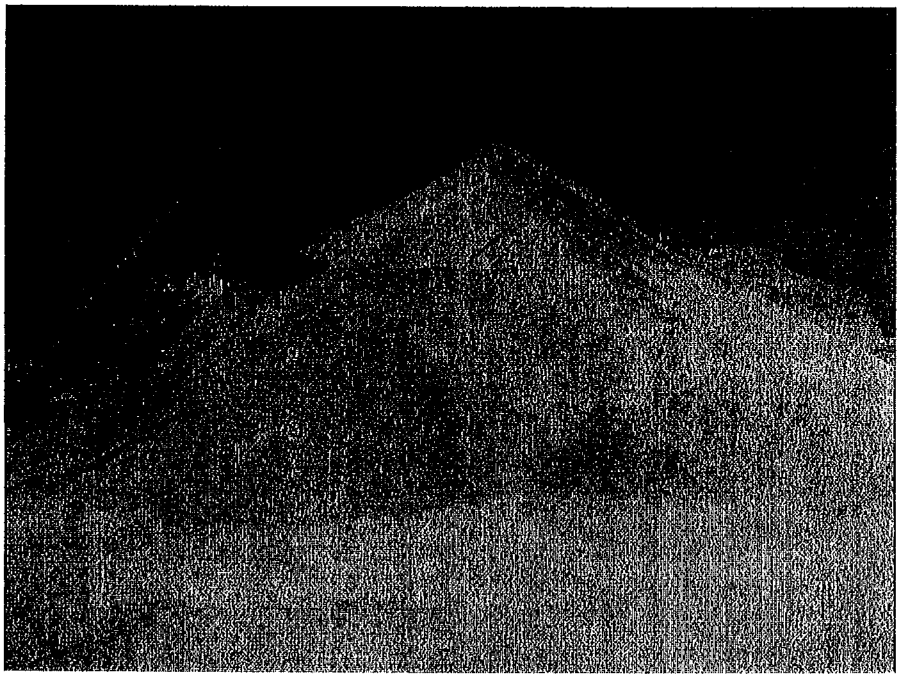


Photo 5-1. Sand Stockpile at the Grimes Rock Quarry

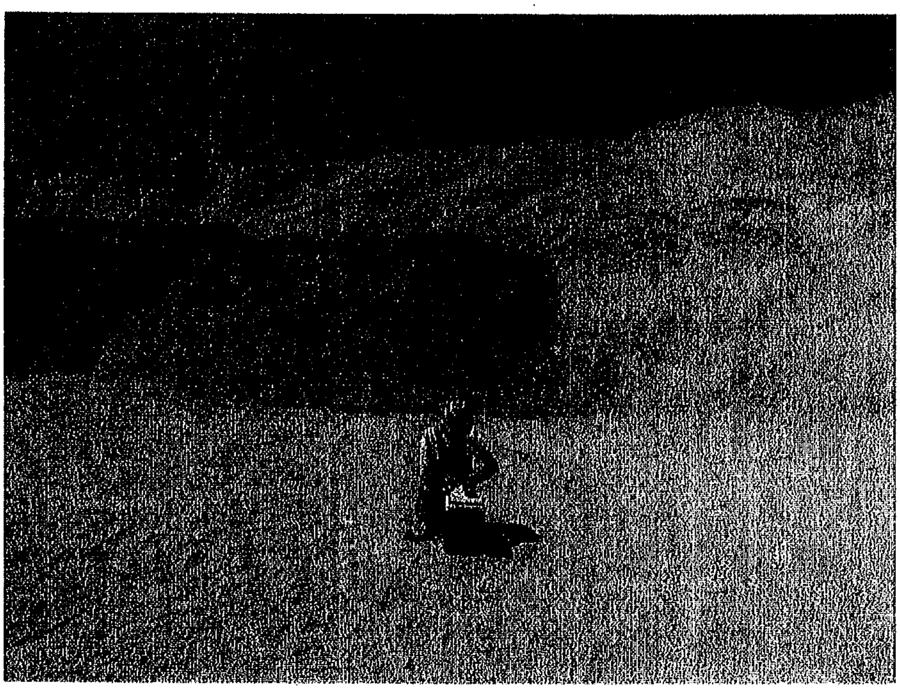


Photo 5-2. Sand Stockpile at the CEMEX Quarry

The beach and dune material would be excavated from one or more of the listed quarries and would be trucked in 14-cubic-yard-capacity, bottom-dump trucks.

Photo 5-3. Sand Stockpile at the P.W. Gillibrand Quarry

5.5 Dune Habitat Restoration

In accordance with governmental agency direction and permitting, the proposed dune restoration Project includes measures to restore native coastal dune habitats through planting of appropriate native dune vegetation, potentially restoring all such areas to their current ESHA designations and protections, consistent with the City of Malibu's LCP/LUP. The BBGHAD proposes native habitat restoration to include planting species such as beach verbena, dune primrose and other characteristic species found in this community. The BBGHAD proposes to assume responsibility for the construction, planting, and maintenance of the restored dune system (BBGHAD Resolution No. 2012/06). A program of initial removal of non-native invasive species such as iceplant (Hottentot fig), pampas grass, myoporum, and European dune grass from areas within and adjacent to the restored dunes would be initiated.

As proposed, signs would be posted to demarcate sensitive dune habitats (e.g. "Habitat Restoration in Progress: Please Keep out of Dune Restoration Areas "). No public access will be permitted on the dunes. By their nature, dunes are an attraction for those who desire to climb up and on top of them. Doing so will reduce the size of the dunes, weaken their structure, adversely affect burgeoning plant life, and create added risk of trespassing into protected ESHA and residential areas. Further, protocols would be implemented for long-term maintenance of restored habitats, including possible use of irrigation if required as an adaptive management measure, ongoing invasive species/weed control and maintenance of signs and access control measures. Private vertical access paths will be created from residences and extend through the dune restoration area to provide access to and from the beach. In general, there will be one shared private access path between adjacent single lots and one private access path for residences that span two or more adjacent lots. The private access paths will be limited to a width of 3 feet and will consist of sand only. The paths will be formed by strategically locating dune troughs and are expected to be maintained by normal foot traffic. Private vertical access paths will be demarcated by symbolic post and cable fencing.

Paths from the residences, the Malibu West Beach Club, and the County-owned vertical access points to the new dry sand beach will provide access for those who have historically used such pathways and also protect newly established and restored dune habitat from random passage to the beach. A conceptual rendering of the dune field looking seaward is shown in Figure 5-6.

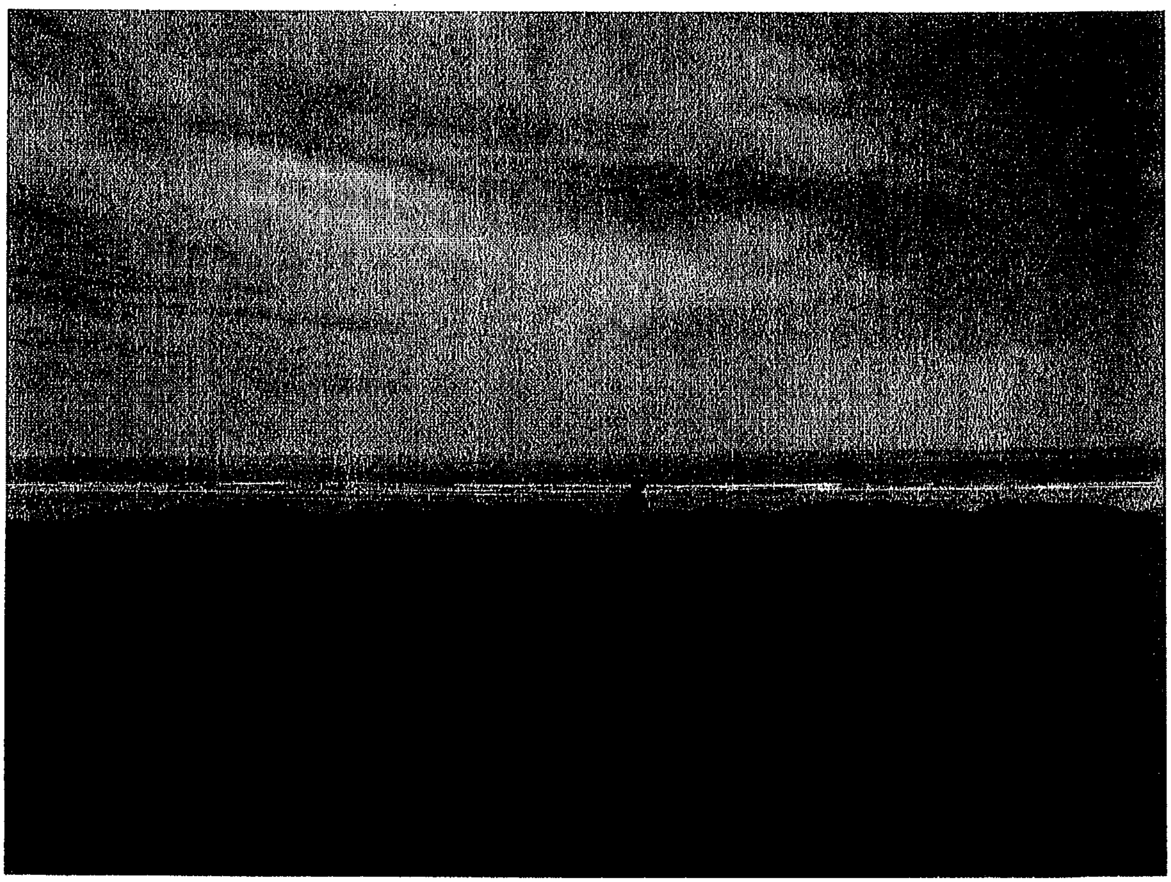


Figure 5-6. Conceptual Rendering of Dune Restoration
Source: Moffatt & Nichol 2017

5.6 Private Property and Public Lateral Access

Currently, public lateral access along Broad Beach is limited to times of low and moderate tides. Public access landward of the MHTL is also affected by uneven distribution of Access and Recreational Use Easements (AREs) for lateral access, which are recorded on approximately 35% of the private parcels along Broad Beach. These AREs typically extend inland on private property between 10 and 25 feet above the MHTL. However, in some areas, the existing revetment now overlies these AREs. Nonetheless, segments of the revetment that overlie existing AREs that have been accepted and recorded by CSLC and various agencies on private land would remain in place with lateral public beach access proposed to be accommodated on the new wide sandy beach.

In recognition of the ancillary public benefits from the Project and in further recognition that existing lateral easements: (a) cover a relatively small portion of the beach; (b) are inconsistent with one another and create uncertainty and confusion; and (c) are of limited value given the absence of a sandy beach under current beach conditions, all existing lateral access OTDs, AREs, and all currently existing lateral access easements are proposed to be suspended for the duration of the Project in accordance with Project specifications and the maintenance of same.

The BBGHAD has proposed to governmental agencies that, for the duration of the Project, the October 2009 survey may serve as the public/private seaward boundary, subject to Project-specific restrictions on access to the restored dunes. To the extent that any restored dune area lies seaward of the October 2009 MHTL (i.e., on public property), the individual BBGHAD property owners would be granted, through appropriate legal means, unrestricted access to the public property seaward of their properties from the 2009 MHTL to the seaward toe of the restored dunes - subject to the use restrictions specified in Project permits. A cross-section of the restored dune and proposed private dune access and public beach dedication is shown in Figure 5-7.

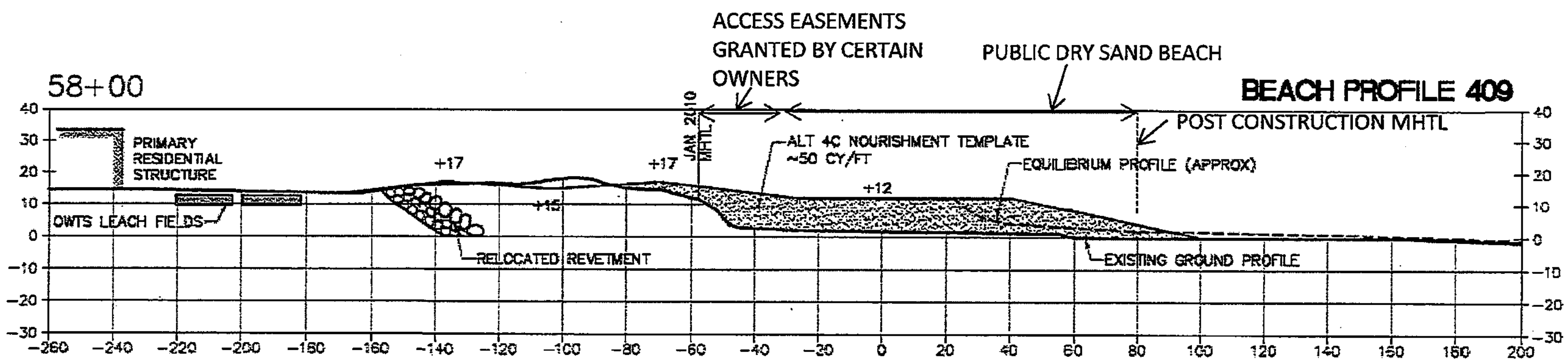


Figure 5-7. Conceptual Cross-Section of Restored Dune and Beach with Existing Offers to Dedicate and Public Beach Area

5.7 Equilibrium of the Beach After Nourishment

For a beach nourishment project, sand is initially placed high on the upper portion of the beach profile above the mean lower low tide area. This is done to expand the level beach berm area for immediate benefit, to retain the sand for as long as possible, and to facilitate construction. The constructed beach immediately incurs change by waves and tides that distributes the sand both offshore and alongshore. As sand redistributes, the nourishment project typically experiences a process of equilibration to a more natural condition of berm width and profile slope that depends on sand grain size and wave energy (the "equilibrium beach profile"). As proposed, the Project is expected to function in a similar manner.

For the Project, the equilibrium beach profile was estimated using several different methods. Essentially, the estimates show that approximately one-quarter to one-half of the width of the beach berm may be lost within approximately one season after construction (depending on conditions and nourishment sand quality), and the slope of the beach flattens (Figure 5-8) as the material deposits slightly farther into the nearshore.

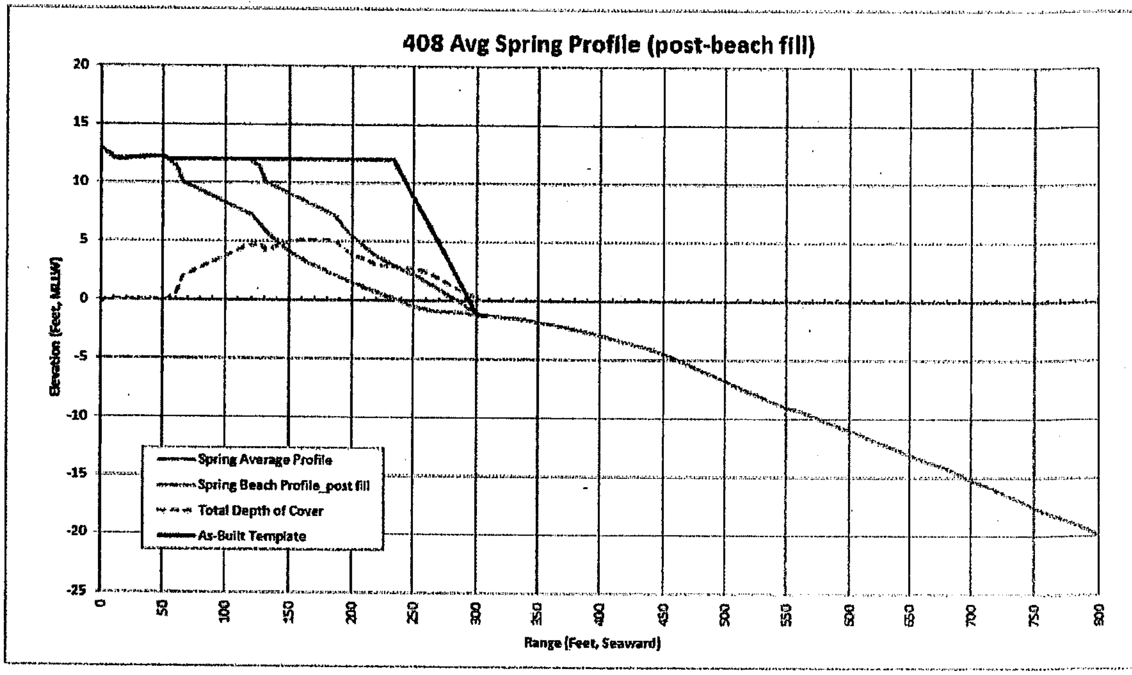


Figure 5-8. Example of Equilibrium Beach Profile for Alternative 4C

5.8 Beach Fill Performance Monitoring

The performance of the beach fill is anticipated to be monitored by a dual program comprising long term beach profile surveys as directed by the CDP and the CSLC, augmented by more frequent measurements of the dry beach berm width. Each program is described as follows:

5.8.1 Long-Term Beach Profile Monitoring

In order to determine the performance of the nourishment Project and monitor the effect of coastal erosion on sand loss on the beach in accordance with direction from governmental agencies, the Applicant proposes to perform long-term beach profile monitoring. This monitoring would be intended to identify and assess coastal erosion and the potential need to initiate backpassing or other proposed nourishment activities to offset such erosion. This monitoring is proposed to include:

1. Measurement points: Monthly measurement (systematically at the same time of each month) of the dry sand beach width (similar to that performed at Zuma Beach by Los Angeles County presently) from the seaward toe of the restored sand dune system to the seaward edge of dry sand "towel area" at nine measurement point profiles specified below and shown on Figure 5-9. The measurement can be done with a tape measure or roll tape, or other suitable low technology device.

   a) 408 (east end – 30756 Broad Beach Road)
   b) 409 (east-central reach – 30916 Broad Beach Road)
   c) 410 (central reach – 31108 Broad Beach Road)
   d) 411 (west-central reach – 31324 Broad Beach Road)
   e) 411.7* (west-central A reach – 31438 Broad Beach Road)
   f) 411.9* (west-central B reach – 31460 Broad Beach Road)
   g) 412 (west end – 31506/31504 Victoria Point Road)
   h) 412.3* (west end A – 31520 Victoria Point Road)
   i) 412.5* (west end B– 31536/31532 Victoria Point Road)

   (These transects were first surveyed in spring 2013 and were added at the request of the California Coastal Commission per its filing status letter dated February 8, 2013.)*

2. Semi-annual (spring and fall) full beach profile measurements out to the closure depth (approximate ocean water depth of 40 feet).
3. Estimation of the rate and trend of beach width change and sand volume change at each of the measurement points for one year prior to construction and continually after construction for 10 years.
4. Zuma Beach Width: A total of seven beach profiles will be surveyed every six (6) months to quantify total sand volume and width changes within the littoral mini-cell between Lechuza Point and Point Dume.

5.8.2 Beach Berm Width Measurements

The BBGHAD has proposed to take more frequent measurements of the beach berm width along Broad Beach to supplement the surveyed beach profiles. As proposed, the measurements would be taken from fixed benchmarks (storm drain outfalls) at the back of the beach to the wetted bound line to provide an approximation of the dry beach width above the mean high water line. This measurement yields data of the dry beach width over time and space. The U.S. Army Corps of Engineers (USACE) performs these types of measurements along Orange County (called "Clancy measurements"). These measurements are quite useful because they are frequent (monthly) and can capture impacts from storm events.

The proposed storm drain outfall structures to be constructed at four locations along the revetment will provide visible and fixed benchmarks ideal for regular beach width measurements. The storm drain outfall structures would be located near profiles 411 (west), 410 (central) and 409 (east) and would provide useful data to supplement the surveyed beach profiles. These three locations would also provide a good indicator of the remaining beach width in front of the revetment at the west, central and east ends of the Project.

In addition to measured beach widths from three benchmarks, the BBGHAD proposes to use a handheld GPS unit to record the horizontal position of the wetted bound line along Broad Beach. This would provide a continuous line from Trancas Creek to Point Lechuza that could be displayed on Project drawings to provide an estimated beach width along the entire Project. The beach widths measured from the benchmarks could then be used to verify and correct coordinates from the handheld GPS unit.

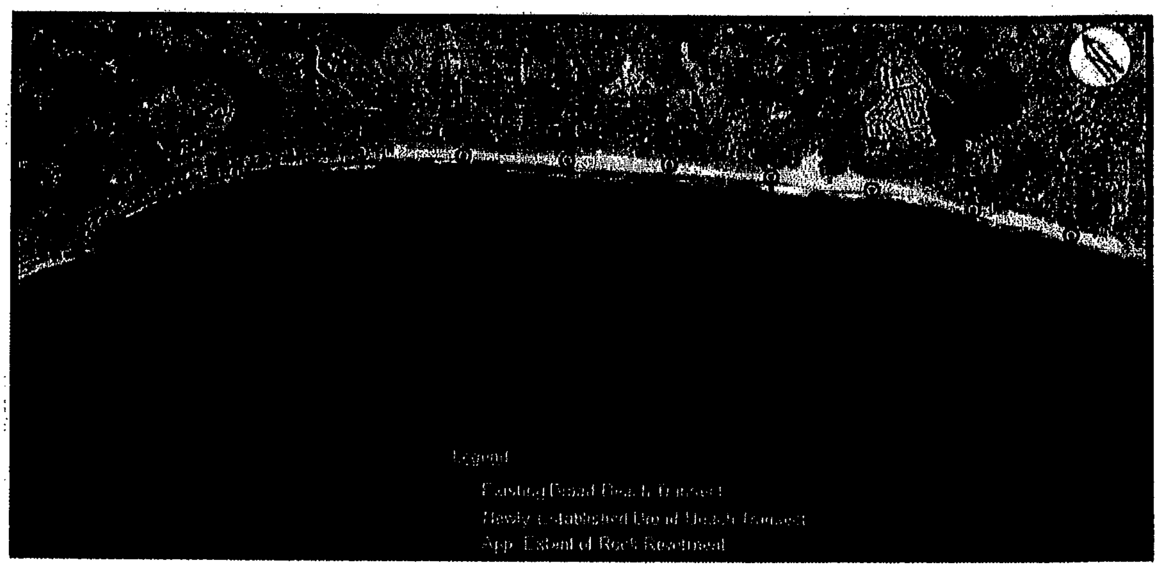


Figure 5-9. Transects for Beach Profiling at Broad Beach and Zuma
Source: Coastal Frontiers 2013

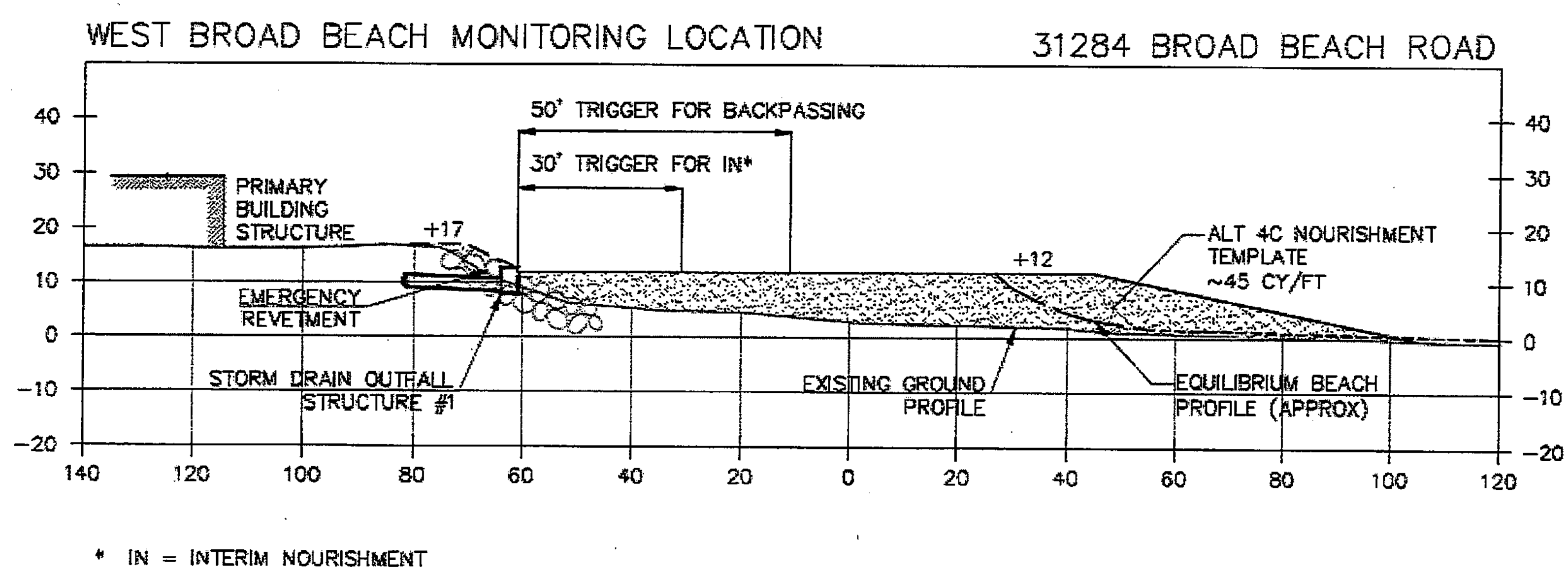
5.9 Adaptive Management Actions

Based on information obtained from the beach profile and beach width monitoring program, and in accordance with direction from the SAP, the BBGHAD will determine if site conditions trigger the need to undertake certain beach management actions. These will identify when beach erosion is reaching a point that threatens Project benefits including protection of private property and recreation, with careful attention to also maintaining public access seaward of the revetment. The triggers are crafted to permit sufficient time to implement management actions to maintain these benefits. The BBGHAD proposes these management actions to maintain a widened beach in an adaptive manner prior to the Major Nourishments at approximately 5 year intervals. In the event of a severe coastal storm wave event or series of events which strip the beach of sand and subject to monitoring results and BBGHAD finances, the BBGHAD seeks the flexibility to conduct Major Nourishments more often than every five (5) years in addition to or in lieu of Interim Nourishments as described below.

Among other potential measures directed by the SAP, adaptive management actions should include: (1) short-term backpassing events meant to prolong the life of the beach nourishment activity and equalize the benefits of the Project among the homeowners within the BBGHAD, and (2) Interim Nourishments of up to 75,000 cubic yards (subject to availability of additional BBGHAD funding). The management actions would be triggered when the beach width data meets the criteria listed below and illustrated in Figure 5-10.

1. **Backpassing,** as proposed, would be triggered when the average dry beach width fronting the western revetment near Transect 411 is approximately 50 feet or less for 3 consecutive months. Beach widths measured from the storm drain outfall structure near Transect 411 (31284 Broad Beach Road), supplemented with surveyed beach profile data at profile 411, would be analyzed to determine when this trigger is met. As proposed by the BBGHAD, if trigger measurements are met in the spring ,then the 3 consecutive month window would be 'tolled' or suspended for the summer months i.e. from Memorial Day to Labor Day as no construction or backpassing activities can occur on the beach during that time.

2. **Interim Nourishments,** as proposed, would be triggered when the average dry beach width fronting the western revetment near Transect 411 is approximately 30 feet or less for 6 consecutive months and is recorded by two (2) consecutive full beach profile surveys <u>and</u> insufficient beach width exists to provide 10,000 cubic yards of backpassing sand from the eastern end of Broad Beach. Beach widths measured from the storm drain outfall structure near Transect 411 (31284 Broad Beach Road), supplemented with surveyed beach profile data at profile 411, would be analyzed to determine when this trigger is met. Should trigger measurements be met in the spring, then the 3 consecutive month window would be 'tolled' or suspended for the summer months i.e. from Memorial Day to Labor Day as no construction or backpassing activities can occur on the beach during that time.



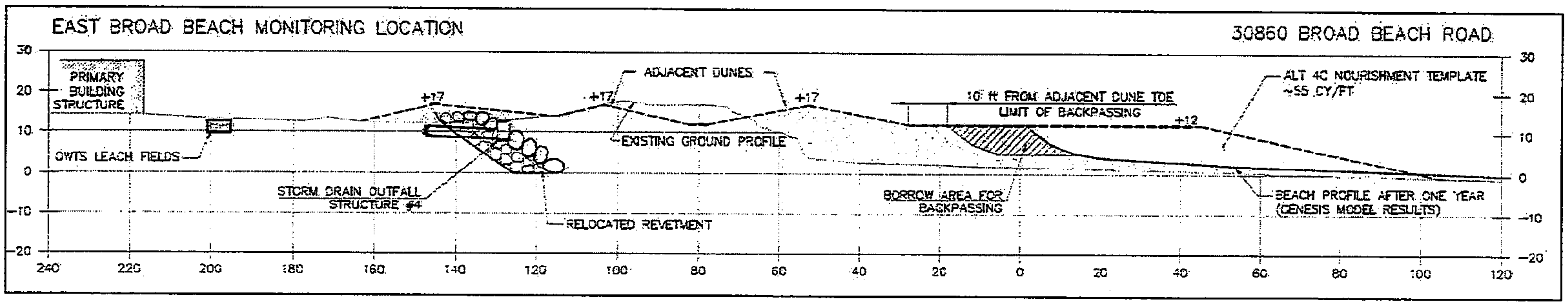


Figure 5-10. Adaptive Management Triggers

5.9.1 Backpassing

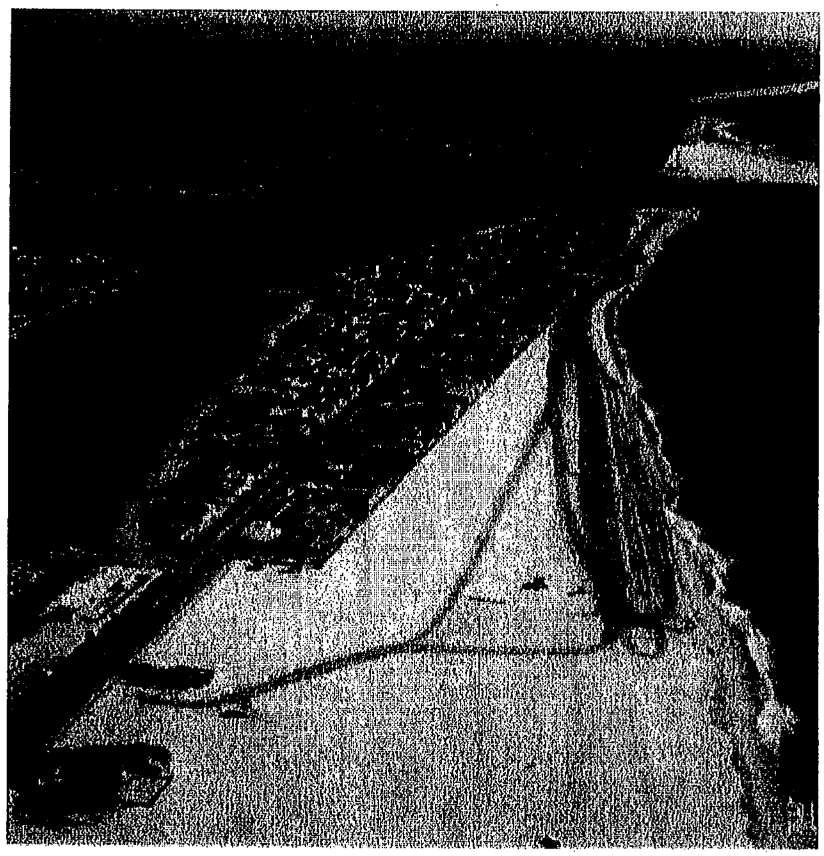


Photo 5-4. Sand Backpassing in Long Beach, CA

As proposed, backpassing would involve the use of heavy equipment (e.g., scrapers, bulldozers) to excavate sand from the downdrift "sand rich" segment of Broad Beach (anticipated to be the eastern reach) and its transport back updrift to the eroding reach of Broad Beach (anticipated to be the western reach of the Alternative 4C footprint). Backpassing is proposed to extend the practical lifetime of this beach nourishment project by recycling sand back updrift within the littoral cell and delay the need for major beach renourishment. Backpassing is less expensive than small-scale nourishment from either onshore sources via trucking due to high unit cost or from offshore dredging due to equipment mobilization costs.

The objective backpassing triggers intend to maintain a balanced benefit of the beach nourishment to the maximum extent practical for BBGHAD purposes, and to maintain dry sand beach seaward of the revetment. As part of the overall Adaptive Management Plan (AMP), these triggers will assist in identifying when beach erosion reaches a point that threatens Project benefits (e.g., protection of private property, lateral access, recreation, etc.) and to permit sufficient time to implement management actions to maintain these benefits. The triggers are meant to be used in combination with on-site observations, beach width measurements, profile monitoring, and an understanding of historical and projected future trends. The BBGHAD proposes to re-evaluate the triggers frequently due to the large variability in potential shoreline change rates.

The concept of sand backpassing was incorporated into the Project at a time when the intended nourishment volume was 600,000 cubic yards. With that volume and resulting beach widths, backpassing was proposed as an effective measure to extend the life of the nourishment by pushing sand from the downdrift, wider portion of the beach and transporting it west to the updrift and narrower reaches. With the Major Nourishment volume reduced to 300,000 cubic yards, the opportunities for effective backpassing of sufficient sand surplus at the downdrift end of the Project may be limited after the first one to two years after Major Nourishments.

Since the net direction of sand movement (littoral drift) is to the east, it is anticipated that the predominant backpassing operation will be from east (surplus) to west (deficit). The resulting action would backpass sand using mechanical equipment (scrapers and bulldozers) from the wide reach of beach (surplus area) to widen the narrow reach (deficit area) of beach.

The anticipated borrow area will extend from Transect 410, near the center of Broad Beach, toward the east for a distance of about 3,000 feet. Along this reach sand will be backpassed from the dry beach (above Mean High Water) while maintaining a 10 foot buffer from the dune restoration area. The sand volume available for backpassing operations within the borrow area will depend on the actual dispersion of the initial beach fill. Modeling results indicate there could be up to 25,000 cubic yards available within this borrow area for the first backpassing operation expected to occur about 1 year after the initial beach fill. A schematic plan and typical section of the borrow area are shown in Figure 5-11 for the first backpassing event. Subsequent events will involve backpassing volumes of 15,000 cubic yards or less. Some undisturbed contiguous stretches between the dune habitat and the nearshore will be retained during any single backpassing event.

The anticipated maximum placement area for backpassed sand will be 500 feet on the west side of Transect 411 and 1,500 feet east of Transect 411 i.e. a total linear length of 2,000 feet between 31108 and 31380 Broad Beach Road. Backpassed sand will be placed up to an elevation of +12 feet, MLLW and within the limits of the original beach fill template. The first backpassing event, expected to occur about 1 year after the initial fill, would increase the beach width by about 40 feet within the placement reach. A schematic plan and typical section of the placement area are shown in Figure 5-12 for the first backpassing event.

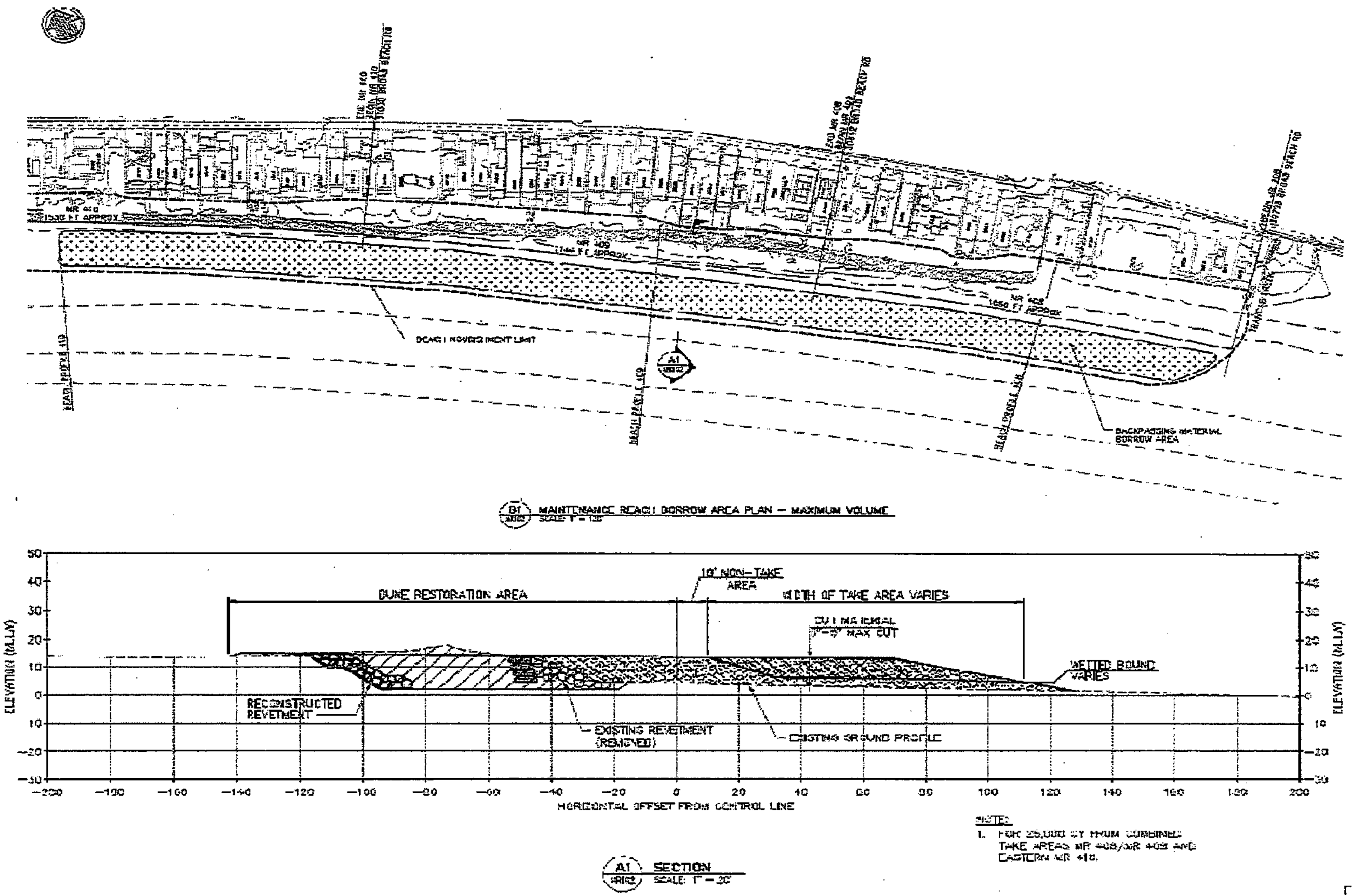


Figure 5-11. Schematic of Borrow Area for Alternative 4C Year 1 Backpassing Operation (25,000 cy)

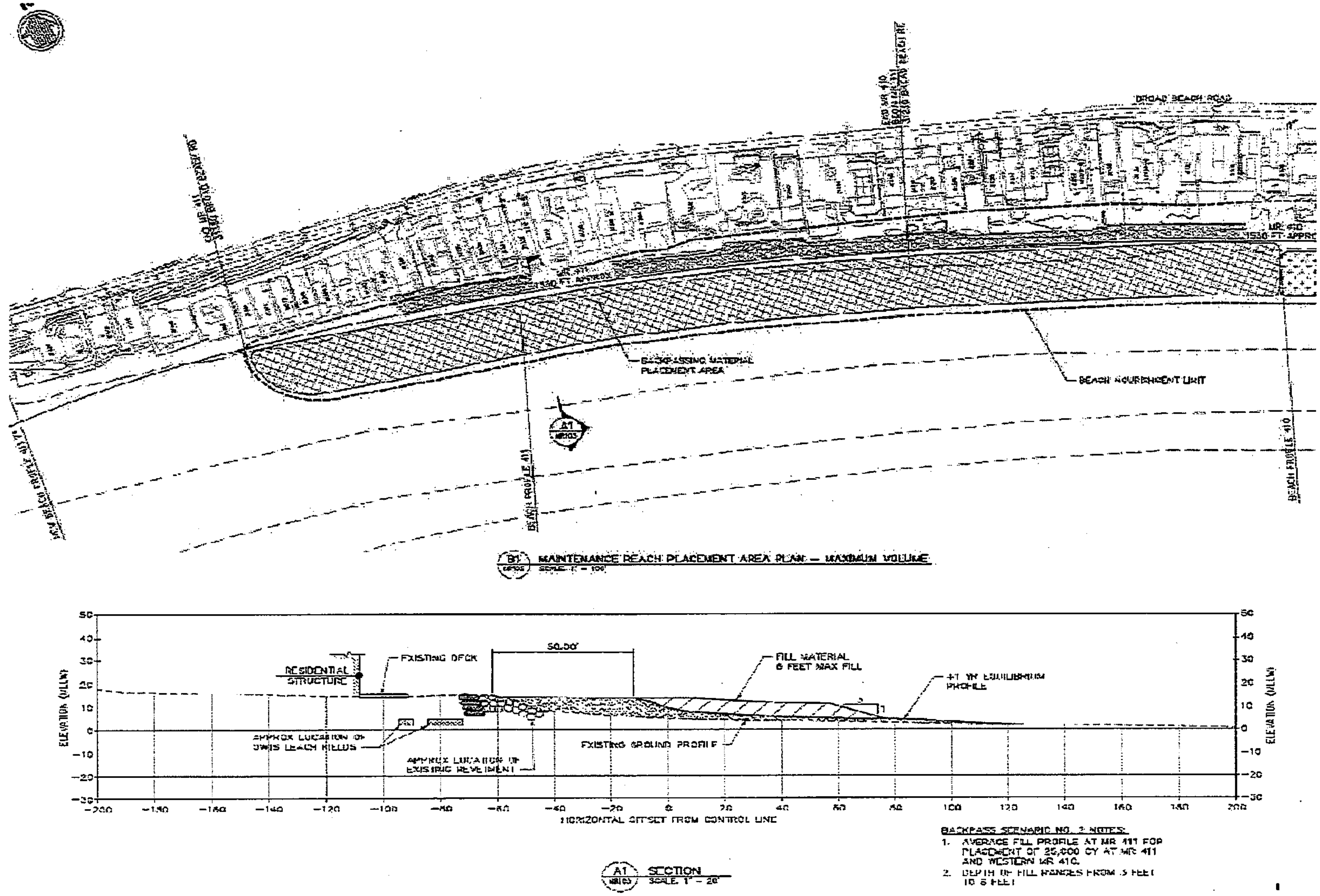


Figure 5-12. Schematic of Placement Area for Alternative 4C Year 1 Backpassing Operation (25,000 cy)

5.9.2 Interim Nourishments

Prior to the scheduled Major Nourishments after the initial sand placement, the need may arise for the placement of additional sand along Broad Beach to maintain Project objectives. Interim Nourishments, at the discretion of the BBGHAD and subject to BBGHAD finances, are proposed as an adaptive management action when beach width along the western portion of Broad Beach has narrowed to the point where seasonal fluctuations in beach width could result in revetment exposure and limited lateral beach access.

When the beach width trigger is reached and backpassing is not feasible, up to 75,000 cubic yards of Interim Nourishment sand (of same specification as original nourishment) would be obtained from an approved sand borrow site, transported from the local inland source(s), and deposited on Broad Beach. This volume will provide approximately 50 feet of dry beach width over a 2,000 foot reach of assumed sand deficit area. The sand source for these renourishments would be the same as for the initial nourishment, unless the applicable agencies approve other borrow sites and all details for construction described in the Project description would apply. A schematic plan and typical section of an Interim Nourishment is shown in Figure 5-13.

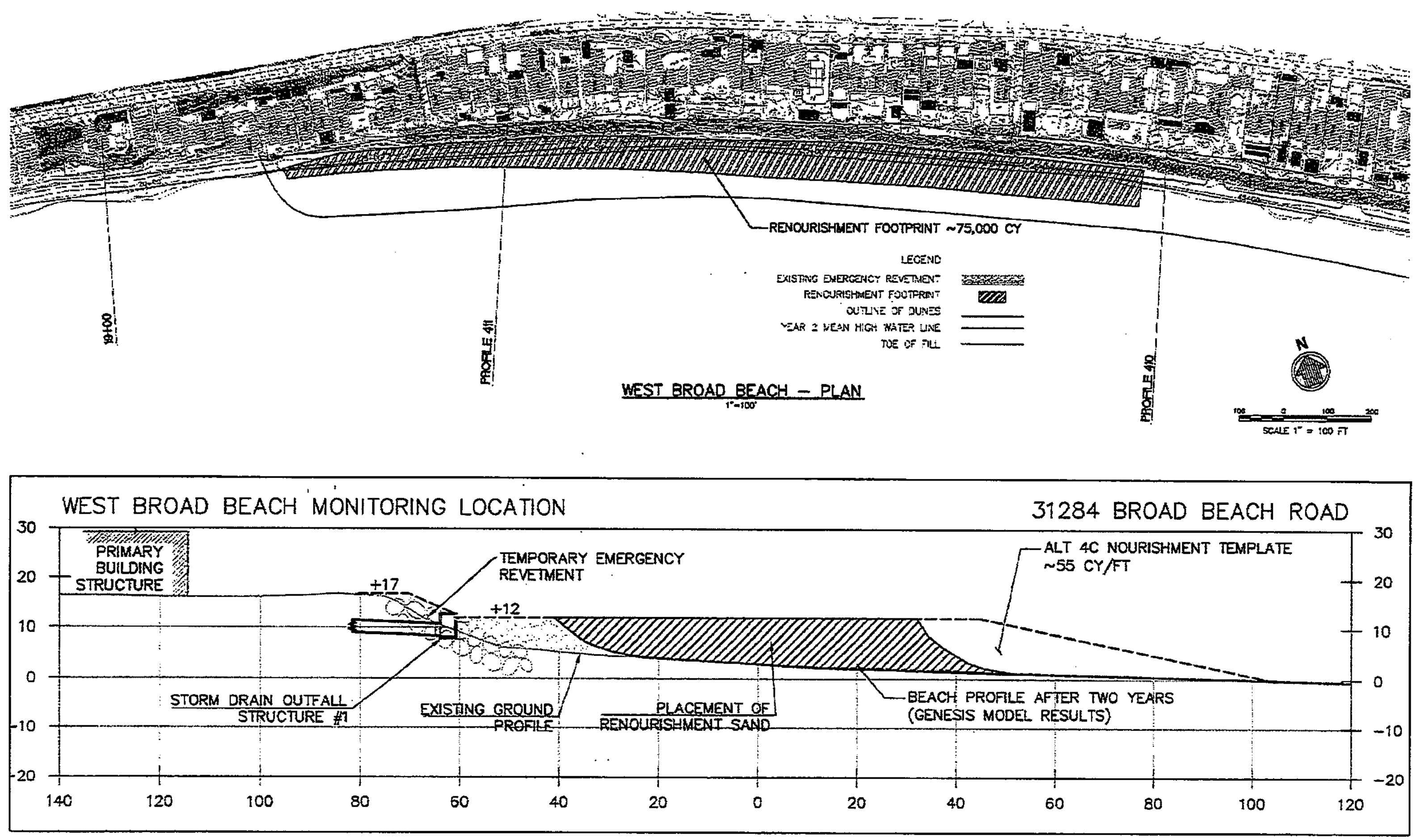


Figure 5-13. Schematic of Placement Area for Alternative 4C Interim Nourishment

5.10 Project Benefits West of 31380 Broad Beach Road

As has been presented within this report, the western extent of the direct placement of beach nourishment sand is at 31380 Broad Beach Road. This reduction in the sand placement "footprint" was required to avoid impacts to sensitive nearshore habitat resources associated with both direct and indirect burial by fill sand. Direct impacts imply sand placed directly on sensitive habitat areas; indirect impacts result from westward and seaward migration of the initially placed fill. Both the analytical and numerical modeling tools used to predict movement of the beach fill material demonstrate that while the majority of the sand is moved toward the east due to the prevailing wave direction, there will be transport of sand westward toward Lechuza Point, therein providing measurable dry sand beach and the related benefits of enhanced shore protection and recreational opportunities. Westward transport of sand is predicted to occur immediately during and following the beach fill due to the change in shoreline orientation caused by the initial fill itself. This simple concept is illustrated in Figure 5-14 below.

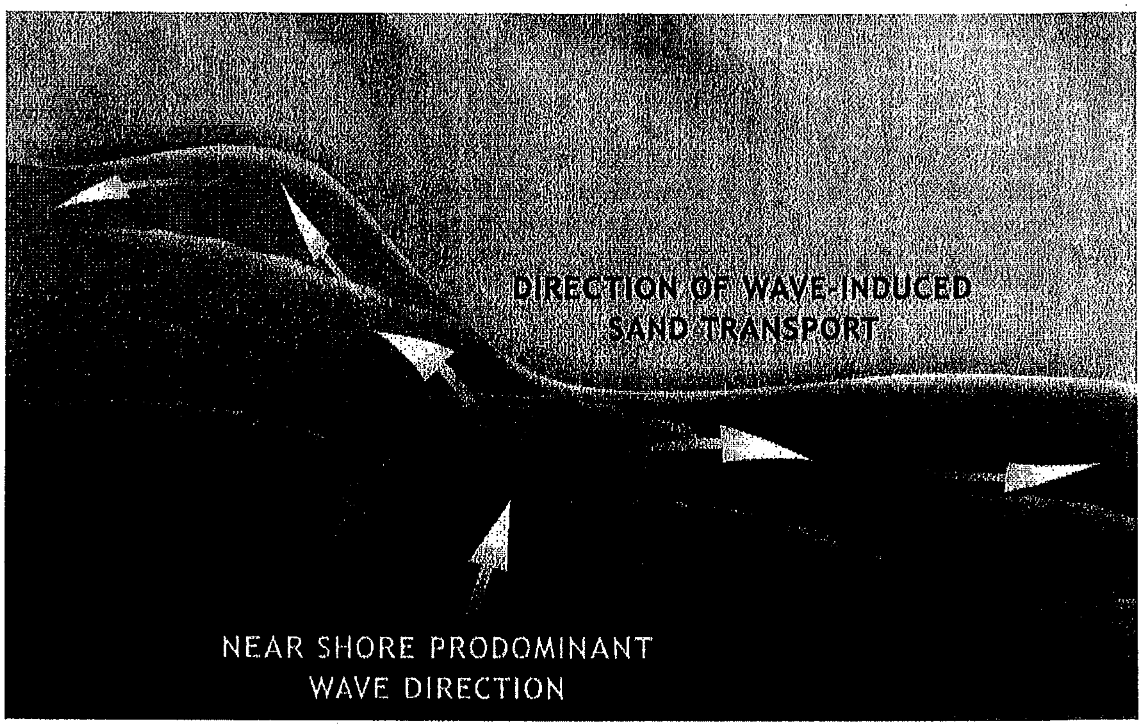


Figure 5-14. Illustration of Bi-Directional Transport of Sand at Edge of Beach Fill

Figure 5-15 illustrates the westerly migration of sand for the initial 300,000 cy fill case alone. The model includes a realistic placement rate of sand, such that at completion of construction, there has been sufficient time for sand to be reworked and moved by wave action. Table 5-1 compares the average beach width gained within the western portion of the beach (west of 31380) with the average width gained over the remaining eastern reach. The table then tabulates the predicted "relative benefit" ratio of beach width added within the western portion of the beach compared to the east.

Table 5-1 Comparison of Average Beach Width Added for West and East Reaches Post 300,000 cy Fill

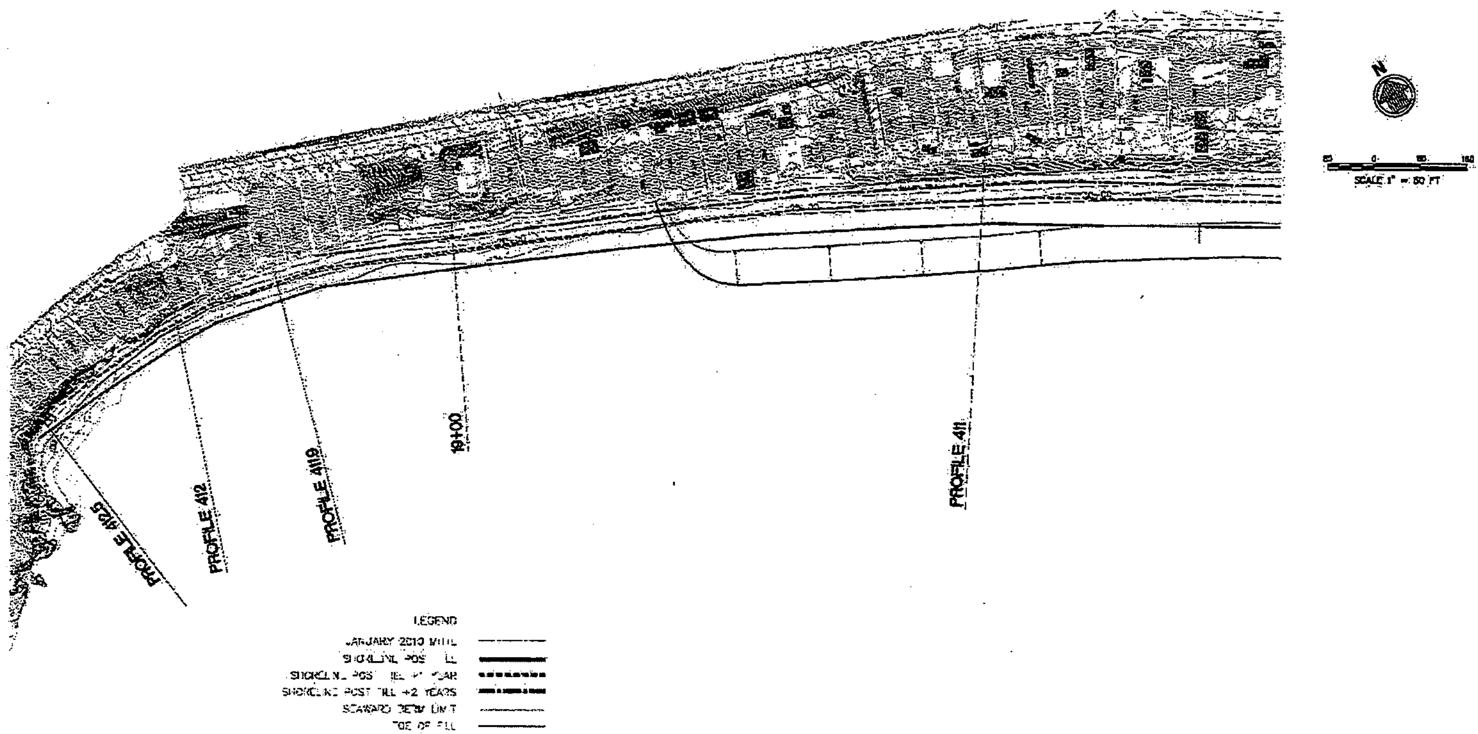
Time after Initial Fill	Average Beach Width Added (West of 31380)	Average Beach Width Added (East of 31380 to 30708)	"Relative Benefit" Ratio of Beach Width Added (West/East of 31380)
0.5 year	50 ft	79 ft	0.63
1 year	34 ft	63 ft	0.55
2 years	10 ft	44 ft	0.22

Figure 5-16 shows the case where an additional 75,000 cy "interim" fill is placed two years after the initial nourishment of 300,000 cy based on the objective triggers discussed previously. When the 75,000 cy interim fill is placed it is assumed that some material remains on the beach two years after the initial 300,000 cy placement. Again, transport of sand westward of the placement footprint is predicted by the model. Table 5-2 compares the average beach width added from the initial nourishment of 300,000 cy and an interim renourishment of 75,000 cy occurring at year 2.

Table 5-2. Comparison of Average Beach Width Added for West and East Reaches Post Initial 300,000 cy Fill With Interim 75,000 cy at Year 2

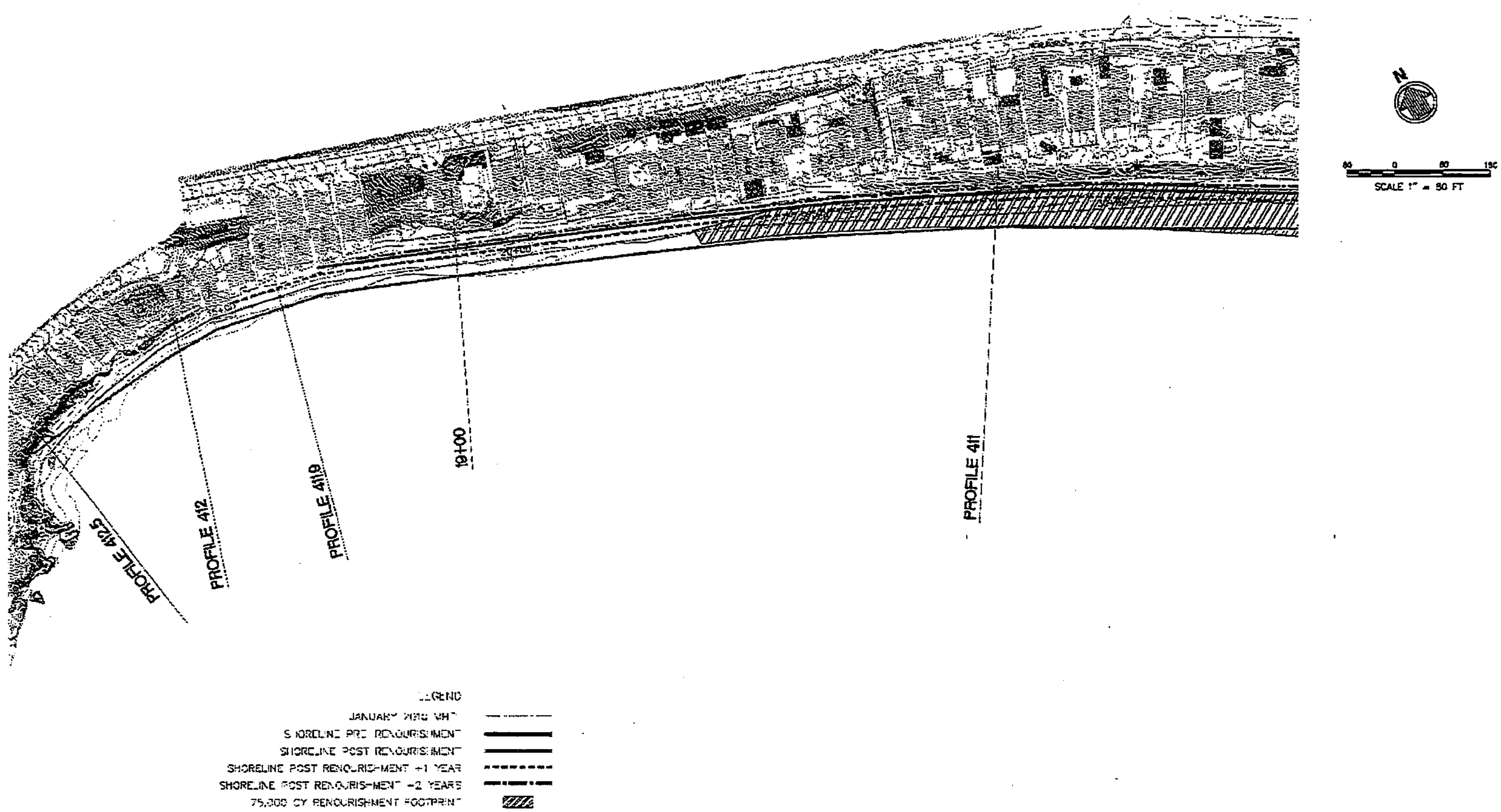
Time after Initial Fill	Average Beach Width Added (West of 31380)	Average Beach Width Added (East of 31380 to 30708)	"Relative Benefit" Ratio of Beach Width Added (West/East of 31380)
0.5 year	50 ft	79 ft	0.63
1 year	34 ft	63 ft	0.55
2 years	10 ft	44 ft	0.22
2.5 years	40 ft	60 ft	0.67
3 years	20 ft	50 ft	0.40
4 years	2 ft	29 ft	0.07

It's important to note these predictions are based on a simplified numerical model with synthetic wave conditions applied. The actual amount of sand transported in a westerly direction will depend on the ocean conditions (weather, waves and water levels) during and after construction. Numerical modeling of shoreline morphology is inherently imprecise because of the complexity of coastal processes. The GENESIS model is intended to provide a generalized long-term trend in shoreline response. Short-term changes in shoreline positions may vary from these results due to the unpredictable and complicated coastal processes which influence Broad Beach and neighboring beaches. The results can be relied upon for anticipating general areas of accretion or erosion at orders of magnitude over large-scales and relative differences between proposed nourishment volumes and shapes, rather than in predicting very precise, site-specific increments of shoreline movement over very small scales.



ALTERNATIVE 4C
SHORELINE CHANGE PREDICTED BY GENESIS
300,000 CY NOURISHMENT

Figure 5-15. Predicted Shoreline Change after 300,000 cy Nourishment



ALTERNATIVE 4C
SHORELINE CHANGE PREDICTED BY GENESIS
75,000 CY RENOURISHMENT

Figure 5-16. Predicted Shoreline Change after 75,000 cy Interim Nourishment

5.11 Analysis of Potential 3-Tier Assessment

The previous 2015 Engineer's Report presented the basis for a two-tier assessment of project cost: (1) those residences receiving direct sand placement (31380 Broad Beach Road and eastward) would be assigned a full 100% share of Project cost; and (2) those remaining residences within the BBGHAD west of the direct placement area would be assigned a reduced 25% share, acknowledging that while they do not receive the benefit of direct sand placement, natural processes of sand transport by wave action and diffusion will result in sand movement toward the west, as described in the preceding Section 5.10. Review of the "relative benefit" ratio of beach width added in the west relative to the direct placement area to the east (Table 5-2, right column) provides support for this 25% assessment.

In an attempt to further balance the cost assessment with benefit, results of the GENESIS Shoreline Evolution Model were revisited to evaluate the performance of the beach fill project over time, and investigate the "relative" benefit accrued at any location within the project. This relative benefit can be quantified in terms of the amount of beach width added at a given location and time, compared to the average added beach width over the entire project (direct sand placement area) at that time. This metric is referred to herein as *Relative Beach Width.* Averaging the Relative Beach Width over the full nourishment cycle (five years) can provide a predictive measure of project benefits upon which a more refined tiered assessment can be based.

Figure 5-17 illustrates the results of the GENESIS Shoreline Evolution Model for the projected project (Alternative 4C), comprising placement of 300,000 cy of initial beach fill, and assuming a single 75,000 cy interim nourishment at Year 2 intended to keep the western portion of the revetment fully covered in sand. The model results clearly illustrate the gradual transport of the sand toward the east over time. Note that sand backpassing, which will tend to reduce the net transport toward the east and hold sand within the project area longer is not included in the model results. The figure illustrates the relative beach width by address and over time. As an illustrative example, Figure 5-17 shows that at Year 1 (orange dots), 31300 Broad Beach Road has a relative beach width of 80%. This implies the added beach width in front of 31300 is 80% of the average beach width over the entire beach fill area. At 30800, the relative beach width at Year 1 (again, orange dot) is 100%, or matches the average beach width at Year 1 for the entire project.

Figure 5-18 presents the average relative beach width added by the project over the full project nourishment cycle, which is at Year 4.5 since Year 5 would include the next 300,000 full nourishment. The graph clearly illustrates the eastern residences garner greater relative beach width over the nourishment cycle. Figure 5-19 illustrates the current two-tier assessment from the 2015 Engineer's Report. Figure 5-20 proposes a more balanced three-tier assessment, with the third added tier representing western residences within the direct sand placement area, but garnering reduced overall project benefit due to the gradual transport of sand toward the east. Over the full 5,000 foot long direct sand placement area, this reduced benefit area ranges from the western limit of direct sand placement at 31380 eastward to the eastern public access stairs at 31202. Over this 1,700 foot long sub-reach of the direct sand placement area, Figure 5-20 illustrates an average relative beach width over a full nourishment cycle of approximately 75%. Based upon analysis of the model results, it appears a reduced assessment level of 75% from 31380 to 31202 represents a more fair and balanced assessment.

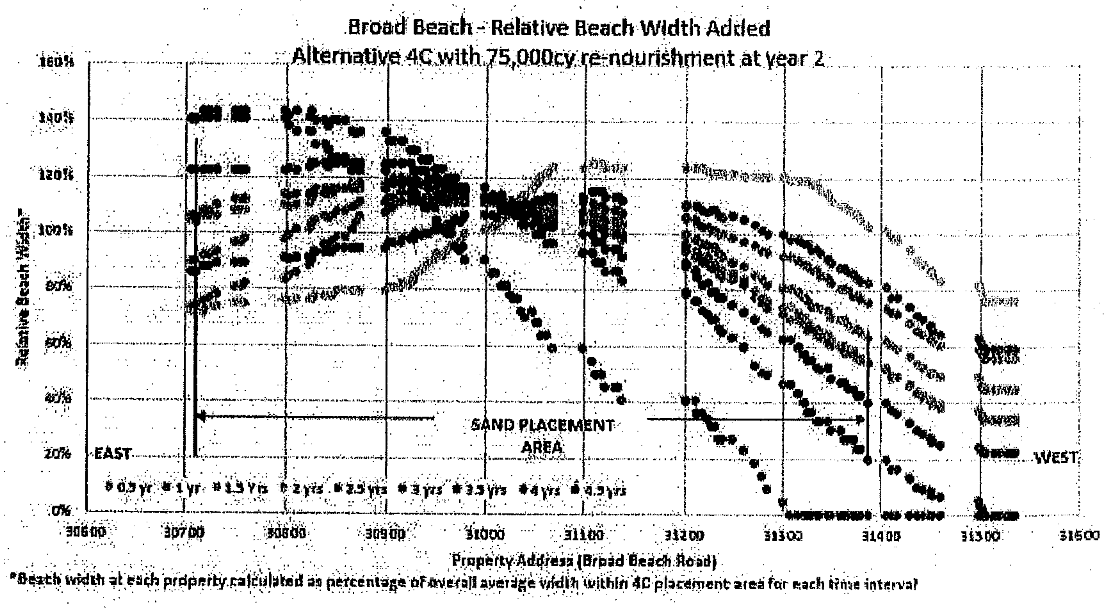


Figure 5-17. Shoreline Evolution Model Results - Relative Beach Width Added by Address Over Time

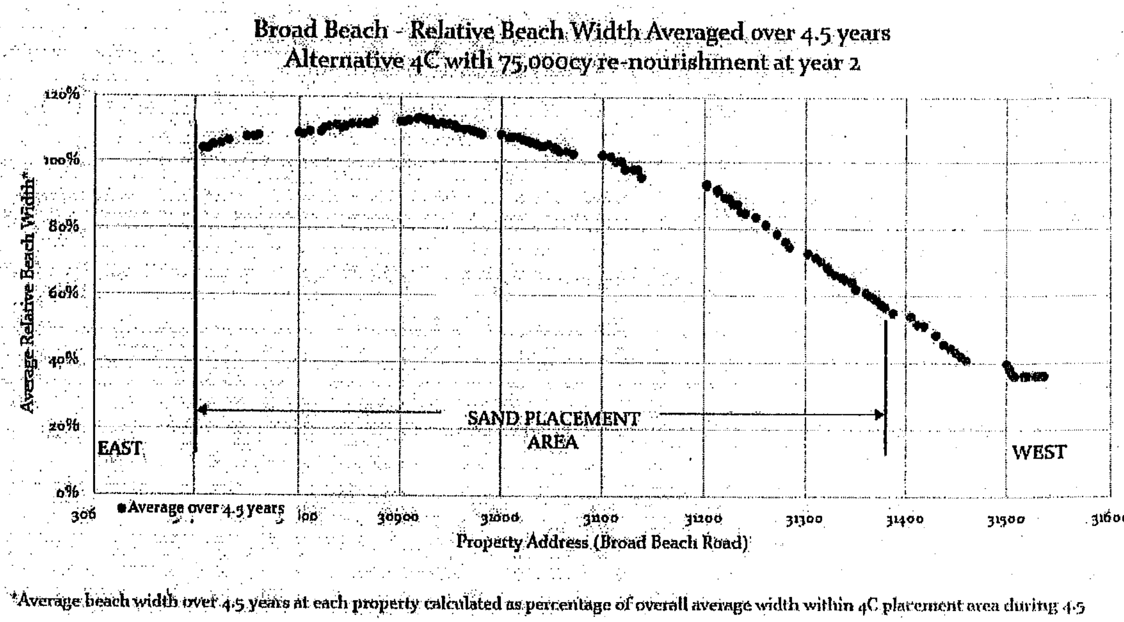


Figure 5-18. Average Relative Beach Width Added Over Full Nourishment Cycle by Address

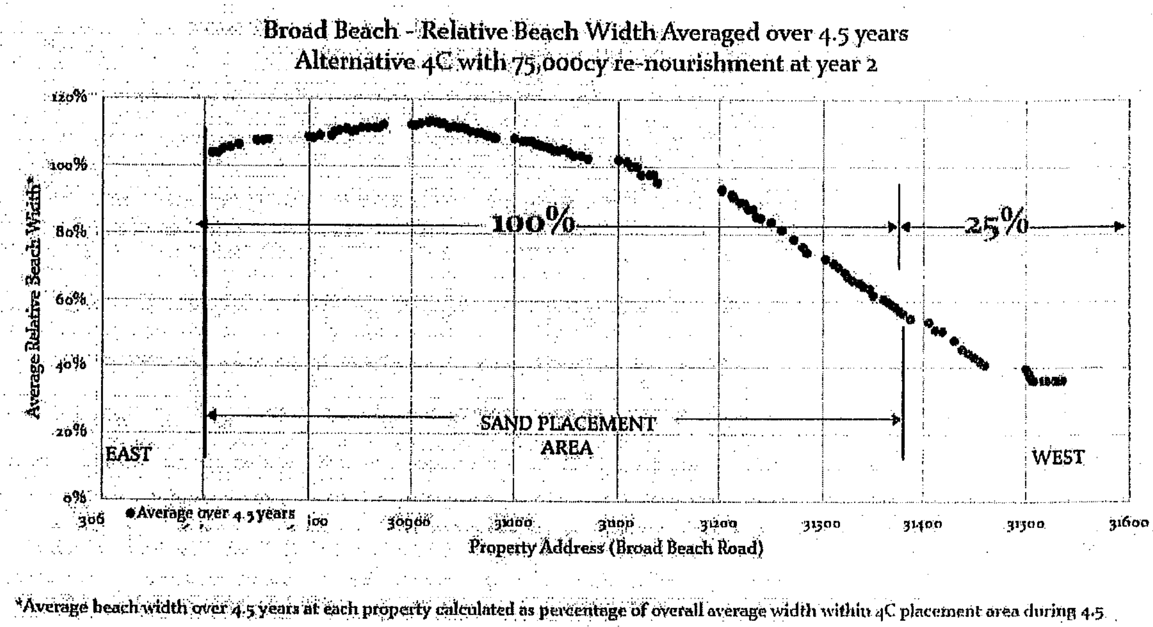


Figure 5-19. BBGHAD 2-Tier Project Cost Assessment Based on 2015 Engineer's Report

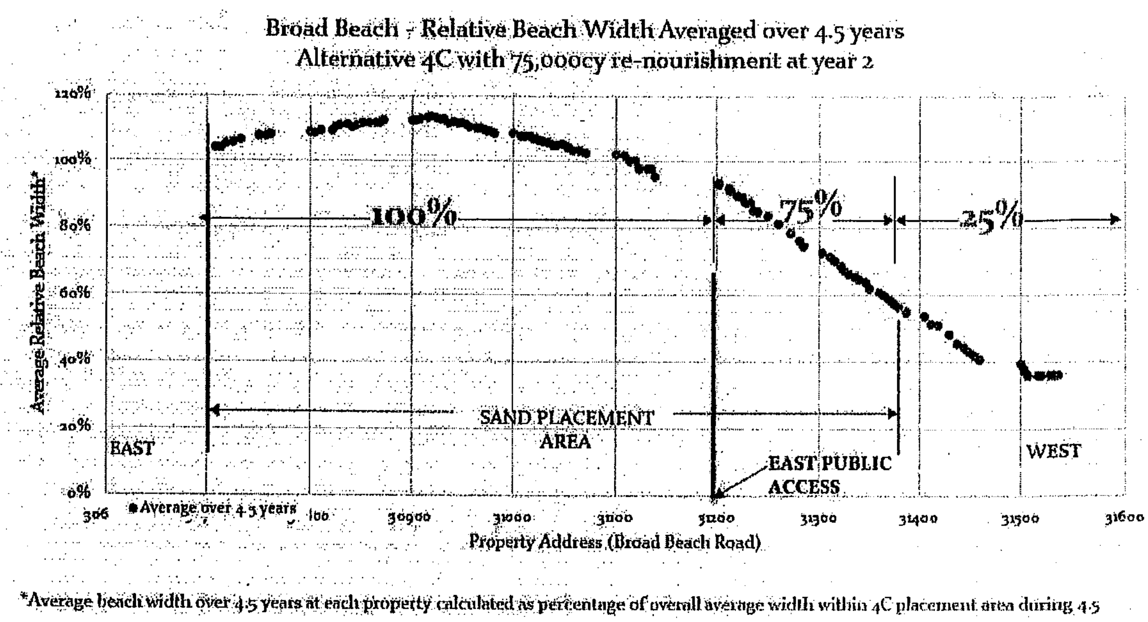


Figure 5-20. Revised BBGHAD 3-Tier Project Cost Assessment

5.12 Partial Revetment Relocation

As part of the long-term strategy for protection of structures, including septic systems, from coastal erosion, the CDP approves of the rock revetment constructed in 2010, and requires the movement of the eastern 1,600-foot portion of the revetment landward of its current location. Similar to the initial construction of the emergency revetment, the cost of relocating the revetment will be borne by the individual homeowners and not a part of the GHAD assessment. The revetment relocation cost is estimated at approximately $1,500 per linear foot.

5.13 Project Construction

As proposed, construction for the proposed Project would involve the following sequence of events – some of the tasks may occur concurrently:

- Transporting the sand via truck from inland quarries.
- An estimated 21,500 truck trips would be required to transport the sand for the initial nourishment of 300,000 cubic yards from the Local Inland Sources.
- Redistributing the sand as needed with earthmoving equipment, such as bulldozers, and grading the beach fills to required dimensions; and
- Annual redistribution of the sand from the wide reach of the beach to the narrow reach using heavy equipment such as scrapers and bull dozers.

5.13.1 Initial Project Construction Schedule

Initial and subsequent Major Nourishment construction activity is estimated to extend over approximately eight (8) months. The window of time when an eight-month Project may occur should extend from approximately September 15 to May 15 of the years of construction. The beach nourishment portion of the Project is anticipated to require approximately four (4) months, with physical construction of the dunes requiring another month. Planting, fencing and signage within the dunes are planned to require another 30 days. Most activities (earthmoving and dune planting) within the Project area would occur between 7 a.m. and 6 p.m. Specifically for inland material, hauling may require 70 working days at five days per week. The BBGHAD has proposed a 14-hour daily trucking schedule beginning at 7 a.m. and ending at 9 p.m. The only construction activities proposed to occur between 6 p.m. and 9 p.m. would be trucking on PCH and stockpiling activities at the Zuma parking lot and on the stockpile areas. No construction activities are proposed to occur west of Trancas Creek between 6 p.m. and 9 p.m. As proposed, the BBGHAD estimates that trucking activities would be completed after 14 weeks.

5.13.2 Construction Staging Area and Equipment

During the construction phase of the Project, the BBGHAD has proposed staging of construction equipment and materials at the western most parking lot of Zuma Beach. Additional temporary staging areas for storage or stockpile of sand may also be established on the beach immediately west of the Zuma Beach parking lot, while maintaining a 100 foot buffer from the Trancas Lagoon. Construction vehicles and equipment are planned to access the site via Pacific Coast Highway into the Zuma Beach parking lot. From the parking lot, equipment would travel down to the wet sand beach and along the beach in front of Trancas Creek and onto Broad Beach. The personnel requirements for the Project would include 12 workers during daytime construction hours (7 a.m. to 9 p.m.). Equipment anticipated to be necessary for construction activities associated with the proposed Project is summarized in Table 5-3 and construction staging and stockpile areas are shown in Figure 5-21.

Table 5-3. Preliminary List of Construction Equipment for the Broad Beach Restoration Project

Support Equipment	Vehicles
Contractor's mobile office (1)	Excavators (3)
Generators (estimated 2)	D-9 Bulldozers (2)
Portable restrooms (3)	Fuel truck (1, not stationed at site); Service truck (1)
Lighting (2 stands)	Delivery trucks (estimated 20)
"Grizzly" (hopper/conveyor system)(3)	Front-End Loaders (3)
Backhoes (3)	Full-size pick-up trucks (2)
Bob-cats (4)	Scrapers (3)
Plant delivery trucks for dunes (20)	Off-road 40-ton Dump Truck (7)

The BBGHAD has proposed that fuel trucks would travel to the staging area at Zuma Beach parking lot every morning to fuel Project equipment. Service trucks providing lubricant and oils for Project equipment would visit the staging area weekly for maintenance. All fueling and/or maintenance of Project equipment would be restricted to the Zuma Beach parking lot and staging area as CSLC policies strictly prohibit this type of activity occurring on or near tidelands. Disturbed areas of the parking lot would be repaved as needed after Project completion.

5.13.3 Construction Procedures

Best Management Practices

The BBGHAD has proposed the implementation of Best Management Practices (BMPs) throughout the construction phase of the proposed Project. As the proponent, the BBGHAD or its contractors would implement site-specific construction mitigation plans, including a traffic minimization plan and equipment refueling plan.

Beach Building

Beaches would be formed by placement of sand from the trucks. Sand would be graded and spread along the beach to the dimensions of the beach fill plan using two bulldozers.

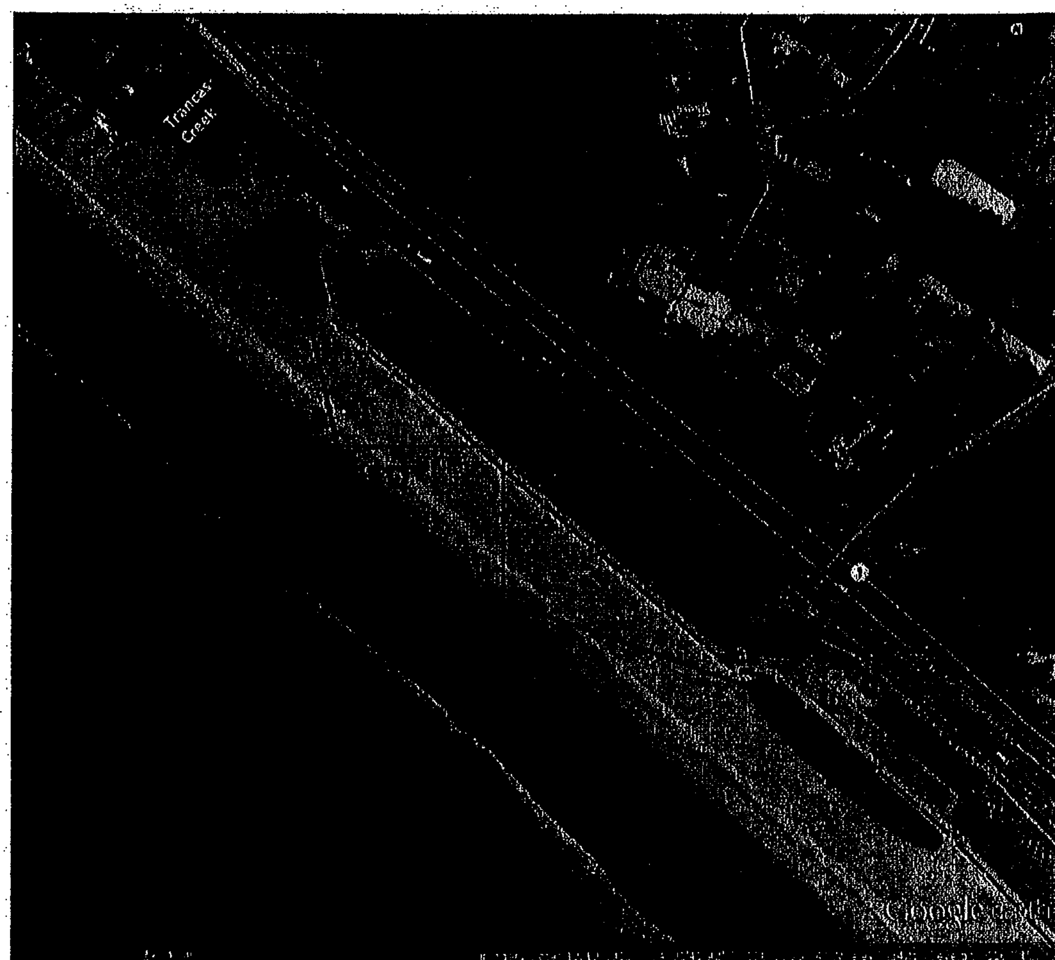


Figure 5-21. Construction Staging & Stockpile Areas For Alternative 4C Project

Dune Building and Restoration

According to the BBGHAD's proposal, the dune would most likely be formed by deposition of sand from the trucking deliveries using loaders and backhoes. Sand would be graded and spread over the existing revetment on the east and up against existing foundations and seawalls in the west height using smaller bulldozers. Existing large-diameter storm drains which currently terminate at the revetment would be protected with a new concrete weir box structure and integrated into the revetment. These drains would issue under the dune and through the beach by percolation. Following sand placement and planting of approved native dune flora, public access would be through existing vertical accessways owned and operated by Los Angeles County and private access to the area would be channeled through pathways to ensure protection of the restored dune habitat.

Transportation from Local Inland Sources

As proposed, trucks hauling sand from the Local Inland Sources and other construction equipment to the Broad Beach site would access the construction staging area located at the western end of the Zuma Beach parking lot via a new temporary driveway opposite Guernsey Drive on Pacific Coast Highway (PCH), and exit the lot via the existing driveway connection to PCH. Trucks would travel southeasterly on PCH and enter the new access driveway on PCH opposite from Guernsey Drive. Although a detailed truck access plan has not yet been prepared, trucks would enter the west end of the Zuma Beach parking lot by turning right from PCH into the new driveway and queue in the parking lot to dump their sand onto grizzlies. After unloading, trucks would exit by heading to the existing driveway at the north end of the Zuma lot and turning left out of the driveway across PCH.[1] This left turn would need to be controlled with a temporary traffic signal as this volume and frequency of trucks could not safely cross the highway without such control. Employees would enter/exit the site via the main gate at the Zuma Beach County Park located east of the site.

The BBGHAD estimates a total of 21,500 loaded truck round trips for the transport of each 300,000 cubic yards of sand between the Local Inland Sources and Broad Beach sites assuming use of 14 cubic yard capacity trucks. It is anticipated that the haul route from the local inland sand source locations to the Broad Beach Project site will be one of those shown in Figure 5-22.

[1] Several access options were considered; however, the size of trucks prohibits using the PCH/Busch Drive underpass 1.5 miles south of the site. Traversing local neighborhoods was also considered and rejected due to local traffic impacts.

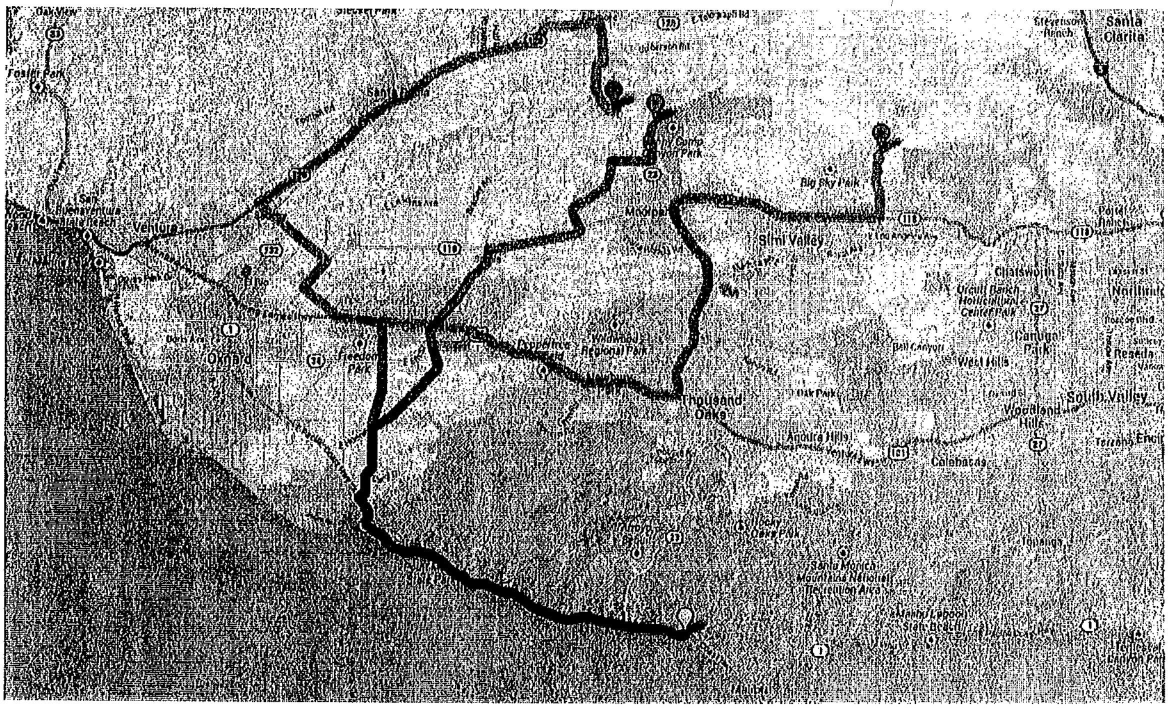


Figure 5-22. Proposed Haul Routes from Local Inland Sand Sources

Trucks would enter the parking lot, drive over a low "grizzly" (hopper and conveyor belt system) that will transport the sand into a stockpile on the beach. Front-end loaders will then load large 40-ton capacity off-road trucks and/or 30 CY scrapers that will drive the material down the beach and drop it within the target placement area. Bulldozers would then shape the placement area into the desired beach fill template. Dunes would be built in a similar way with front-end loaders moving sand dropped along the toe of the revetment up into the dune template, with small dozers or "bobcats" forming the dunes into their final templates.

Public Access During Construction

As proposed, public access during nourishment and dune restoration activities would be maintained to the maximum extent possible. At least two weeks prior to commencing nourishment operations, signs notifying the public of the dates of nourishment operations would be posted at the public access points and at other highly visible locations along the beach. Public lateral access to Broad Beach would be restricted during working hours (7 a.m. to 6 p.m., Monday through Friday) due to the equipment traffic associated with the beach nourishment activities. The Zuma Parking Lot 12 and the beach area at the stockpile will be closed to the public during sand delivery hours of 7 a.m. to 9 p.m. On weekends and holidays, the BBGHAD has proposed that the beach would remain open for public access. As work progresses, public access to portions of the beach would be allowed during nourishment operations to the extent possible with implementation of a construction vehicle traffic management plan. For example, as beach placement is completed at the western end of the Project, this area would become available for public use. The areas of active work (e.g., access routes and areas where earthmoving equipment is being used, etc.) would be clearly delineated with access controlled by the contractor.

Backpassing Activities

Each backpassing operation would require approximately up to three weeks to complete, dependent on the amount of sand to be moved, and would include five personnel, one bulldozer, three scrapers, and a supervisor/foreman vehicle. Standard earthmoving BMPs would be used to reduce impacts from these operations.

The contractor would establish a haul route along the seaward edge of the beach, maximizing the distance between the work and residences. The contractor would establish fencing or signs to control public access to the work site. Access points through the work zone would be continuously manned by construction monitors. Sand backpassing implementation would be expected to commence in the fall season and is estimated to occur over a one and a half to three week (7 to 15 working day) period. The equipment would typically operate on a 12-hour basis between 7 a.m. and 7 p.m., and approximately 5,000 cubic yards per day would be moved.

Backpassing would utilize the west end of Zuma Beach's parking lot for a staging area, as described for beach nourishment. Up to 1.5 acres would be required. Ingress and egress for the construction equipment to the staging area would be via existing driveways off Pacific Coast Highway; access to the beach would be via the existing curb cut at the parking lot's west end. As proposed, the staging area would accommodate construction, materials, parking of support vehicles, and assembly of construction crews. The site would be fenced off and equipment will be stored overnight. This site was previously used for the 2010 emergency rock revetment Project.

6. Summary Discussion of Project Benefits

Primarily, the Project seeks to provide the benefit of shoreline restoration and protection of coastal property from damages related to shoreline erosion and resulting direct exposure to high water levels and storm waves. These benefits would be achieved by restoring the historically wide sandy beach and dune system exemplified by Broad Beach of the early 1970s.

Implementation, maintenance, and protection of these improvements provide a special benefit to all property owners within the project area. Property owners derive special benefit based in direct proportion to their respective beach frontage. Although volumes of sand may differ from time to time on each parcel, the dynamic nature of beach erosion, subsequent sand transport, and the anticipated backpassing and interim/erosion fill maintenance activities renders the environment within the project boundaries as a semi-closed, discrete system in which special benefit is derived based on proportional beach frontage. Therefore, owners with greater beach frontage derive greater special benefit than owners with lesser beach frontage. The proposed improvements combined with the anticipated adaptive management actions help equalize the special benefit derived by properties within the project area based on pro rata length of beachfront per assessed parcel.

7. References

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EXHIBIT E

Assessment Diagram

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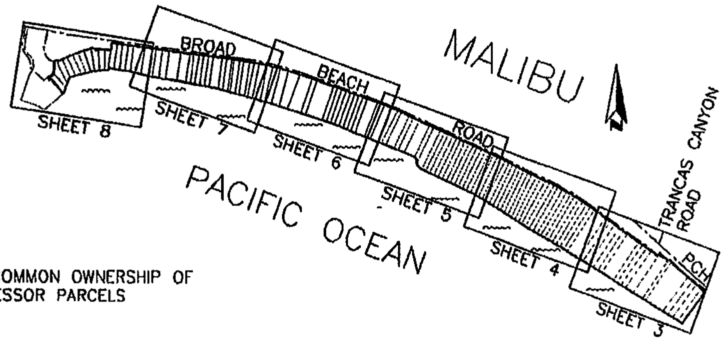
ASSESSMENT DIAGRAM



☐ REPRESENTS COMMON OWNERSHIP OF MULTIPLE ASSESSOR PARCELS

#	ASSESSOR PARCEL #	STREET ADDRESS	FRONTAGE CALCULATION
1	4469-026-009	30708 PACIFIC COAST HWY	48'
2	4469-026-008	30712 PACIFIC COAST HWY	57'
3	4469-026-007	30718 PACIFIC COAST HWY	50'
4	4469-026-006	30724 PACIFIC COAST HWY	50'
5	4469-026-005	30732 PACIFIC COAST HWY	190'
6	4469-026-011	30750 PACIFIC COAST HWY	30'
7	4469-026-016	30756 PACIFIC COAST HWY	100'
8	4469-026-002	30760 BROAD BEACH RD	80'
9	4469-026-012	30800 BROAD BEACH RD	50'
10	4470-013-028	30804 BROAD BEACH RD	42'
11	4470-013-002	30810 BROAD BEACH RD	42'
12	4470-013-030	NO ADDRESS	84'
12	4470-013-029	NO ADDRESS	42'
13	4470-013-004	30826 BROAD BEACH RD	42'
14	4470-013-005	30830 BROAD BEACH RD	55'
15	4470-013-006	30838 BROAD BEACH RD	40'
16	4470-013-007	30842 BROAD BEACH RD	50'
17	4470-013-008	30846 BROAD BEACH RD	60'
18	4470-013-009	30852 BROAD BEACH RD	39'
18	4470-013-010	30856 BROAD BEACH RD	39'
18	4470-013-011	30860 BROAD BEACH RD	39'
19	4470-013-012	30866 BROAD BEACH RD	39'
20	4470-013-013	30870 BROAD BEACH RD	39'
21	4470-013-014	30874 BROAD BEACH RD	39'
22	4470-013-015	30900 BROAD BEACH RD	39'
23	4470-013-016	30904 BROAD BEACH RD	39'
24	4470-013-017	30908 BROAD BEACH RD	39'
25	4470-013-018	30916 BROAD BEACH RD	39'
26	4470-013-019	30918 BROAD BEACH RD	39'
27	4470-013-020	30924 BROAD BEACH RD	39'
28	4470-013-021	30928 BROAD BEACH RD	39'
29	4470-013-022	30930 BROAD BEACH RD	39'
30	4470-013-023	30936 BROAD BEACH RD	39'
31	4470-013-024	30940 BROAD BEACH RD	39'
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35	4470-014-001	30956 BROAD BEACH RD	40'
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37	4470-014-003	30966 BROAD BEACH RD	40'
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51	4470-014-017	31038 BROAD BEACH RD	40'
52	4470-014-018	31042 BROAD BEACH RD	40'
53	4470-014-019	31048 BROAD BEACH RD	40'
54	4470-014-020	31052 BROAD BEACH RD	40'

PREPARED BY:

Richard C. Maher

1/18/2012
DATE

RICHARD C. MAHER, PLS 7564
THIS DOCUMENT IS PRELIMINARY UNLESS SIGNED

LICENSED LAND SURVEYOR
RICHARD C. MAHER
NO. 7564
STATE OF CALIFORNIA

KDM MERIDIAN, INC. (949)768-0731

01/18/12

ASSESSMENT DIAGRAM

☐ REPRESENTS COMMON OWNERSHIP OF MULTIPLE ASSESSOR PARCELS

(#)	ASSESSOR PARCEL #	STREET ADDRESS	FRONTAGE CALCULATION
55	4470-014-021	31054 BROAD BEACH RD	40'
56	4470-014-022	31058 BROAD BEACH RD	40'
57	4470-015-030	31064 BROAD BEACH RD	62'
[58]	4470-015-031	31070 BROAD BEACH RD	45'
[58]	4470-015-004	31100 BROAD BEACH RD	99'
59	4470-015-029	31108 BROAD BEACH RD	60'
[60]	4470-015-027	31112 BROAD BEACH RD	40'
[60]	4470-015-006	31118 BROAD BEACH RD	80'
61	4470-015-007	31122 BROAD BEACH RD	38'
62	4470-015-033	31134 BROAD BEACH RD	104'
63	4470-015-011	31138 BROAD BEACH RD	35'
[64]	4470-015-012	31202 BROAD BEACH RD	51'
[64]	4470-015-013	31206 BROAD BEACH RD	40'
65	4470-015-014	31212 BROAD BEACH RD	40'
66	4470-015-015	31214 BROAD BEACH RD	40'
67	4470-015-016	31220 BROAD BEACH RD	40'
68	4470-015-017	31224 BROAD BEACH RD	40'
69	4470-015-018	31228 BROAD BEACH RD	40'
70	4470-015-019	31232 BROAD BEACH RD	40'
71	4470-015-020	31236 BROAD BEACH RD	40'
72	4470-015-021	31240 BROAD BEACH RD	40'
73	4470-015-032	31250 BROAD BEACH RD	160'
74	4470-015-025	31260 BROAD BEACH RD	45'
75	4470-016-032	31272 BROAD BEACH RD	120'
76	4470-016-003	31280 BROAD BEACH RD	88'
77	4470-016-004	31284 BROAD BEACH RD	75'
78	4470-016-037	31302 BROAD BEACH RD	68'
79	4470-016-036	31310 BROAD BEACH RD	45'
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81	4470-016-028	31322 BROAD BEACH RD	45'
82	4470-016-027	31324 BROAD BEACH RD	34'
83	4470-016-008	31330 BROAD BEACH RD	47'
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86	4470-016-012	31346 BROAD BEACH RD	48'
87	4470-016-013	31350 BROAD BEACH RD	41'
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89	4470-016-016	31364 BROAD BEACH RD	40'
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97	4470-017-068	31418 BROAD BEACH RD	60'
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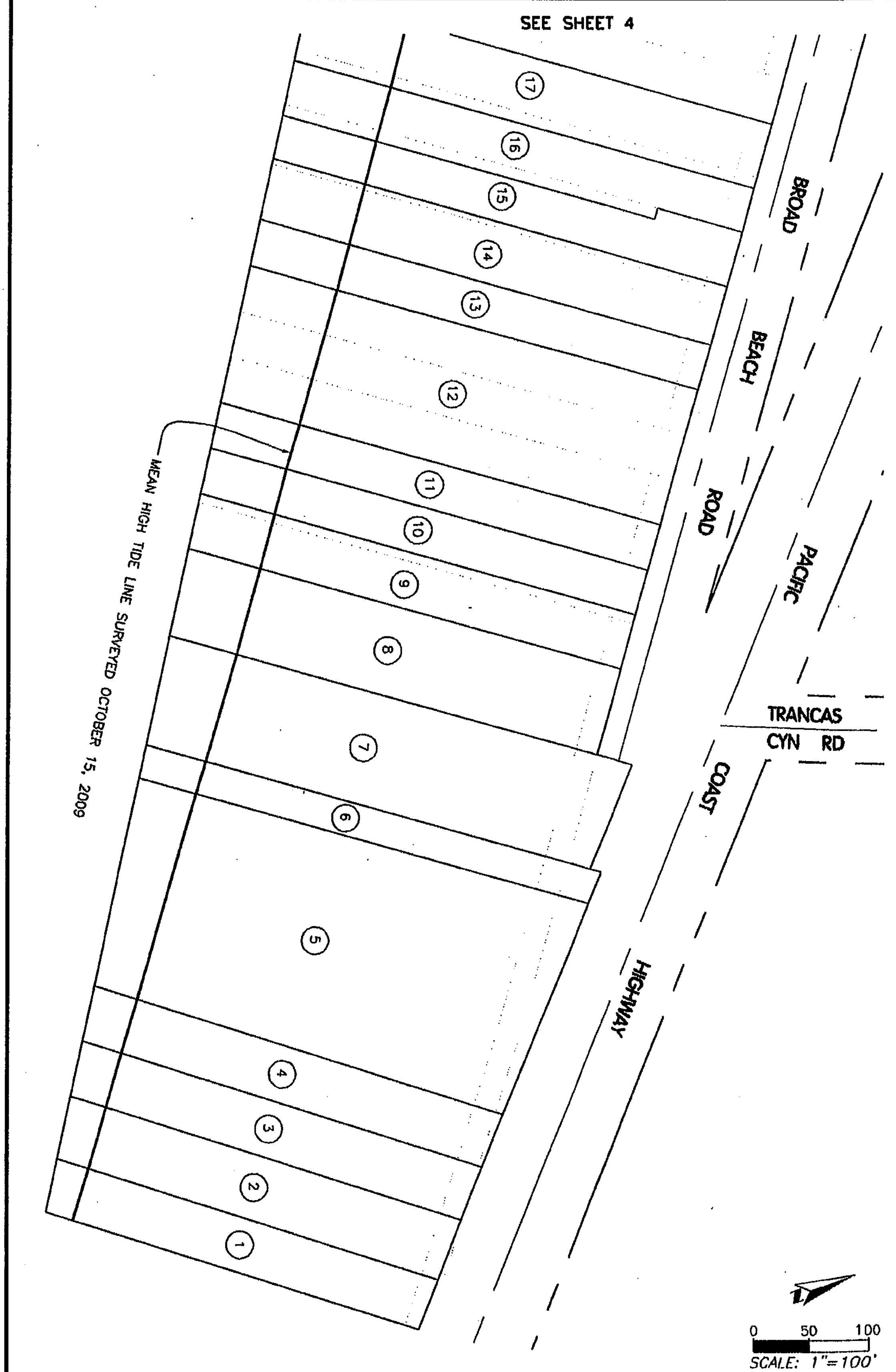
[98]	4470-017-066	NO ADDRESS	50'
99	4470-017-065	31438 BROAD BEACH RD	50'
100	4470-017-064	31444 BROAD BEACH RD	50'
101	4470-017-063	31450 BROAD BEACH RD	50'
102	4470-017-062	31454 BROAD BEACH RD	50'
103	4470-017-061	31460 BROAD BEACH RD	51'
104	4470-017-038	31500 VICTORIA POINT RD	47'
105	4470-017-037	31502 VICTORIA POINT RD	49'
106	4470-017-036	31504 VICTORIA POINT RD	54'
107	4470-017-035	31506 VICTORIA POINT RD	46'
108	4470-017-034	31508 VICTORIA POINT RD	46'
109	4470-017-033	31516 VICTORIA POINT RD	51'
110	4470-017-032	31520 VICTORIA POINT RD	50'
111	4470-017-031	31528 VICTORIA POINT RD	50'
112	4470-017-030	31532 VICTORIA POINT RD	51'
113	4470-017-029	31536 VICTORIA POINT RD	53'
114	4470-017-028	6525 POINT LECHUZA DR	58'

NOTE:
FRONTAGE CALCULATIONS ARE THE INVERSE DISTANCE BETWEEN THE INTERSECTIONS OF THE MEAN HIGH TIDE LINE SURVEYED ON OCTOBER 15TH, 2009 WITH PROPERTY SIDE LINES. FROM ASSESSOR PARCEL NUMBER 4470-017-028 EASTERLY TO ASSESSOR PARCEL NUMBER 4470-017-063 THE MEAN HIGH TIDE LINE LIES AT SEA WALLS OR ON AN EXISTING ROCK REVETMENT. ITS LOCATION WAS DETERMINED FROM AERIAL PHOTOGRAMETRY CONTOURS COMPILED FROM PHOTOGRAPHY COLLECTED ON OCTOBER 15TH, 2009.

01/18/12

ASSESSMENT DIAGRAM



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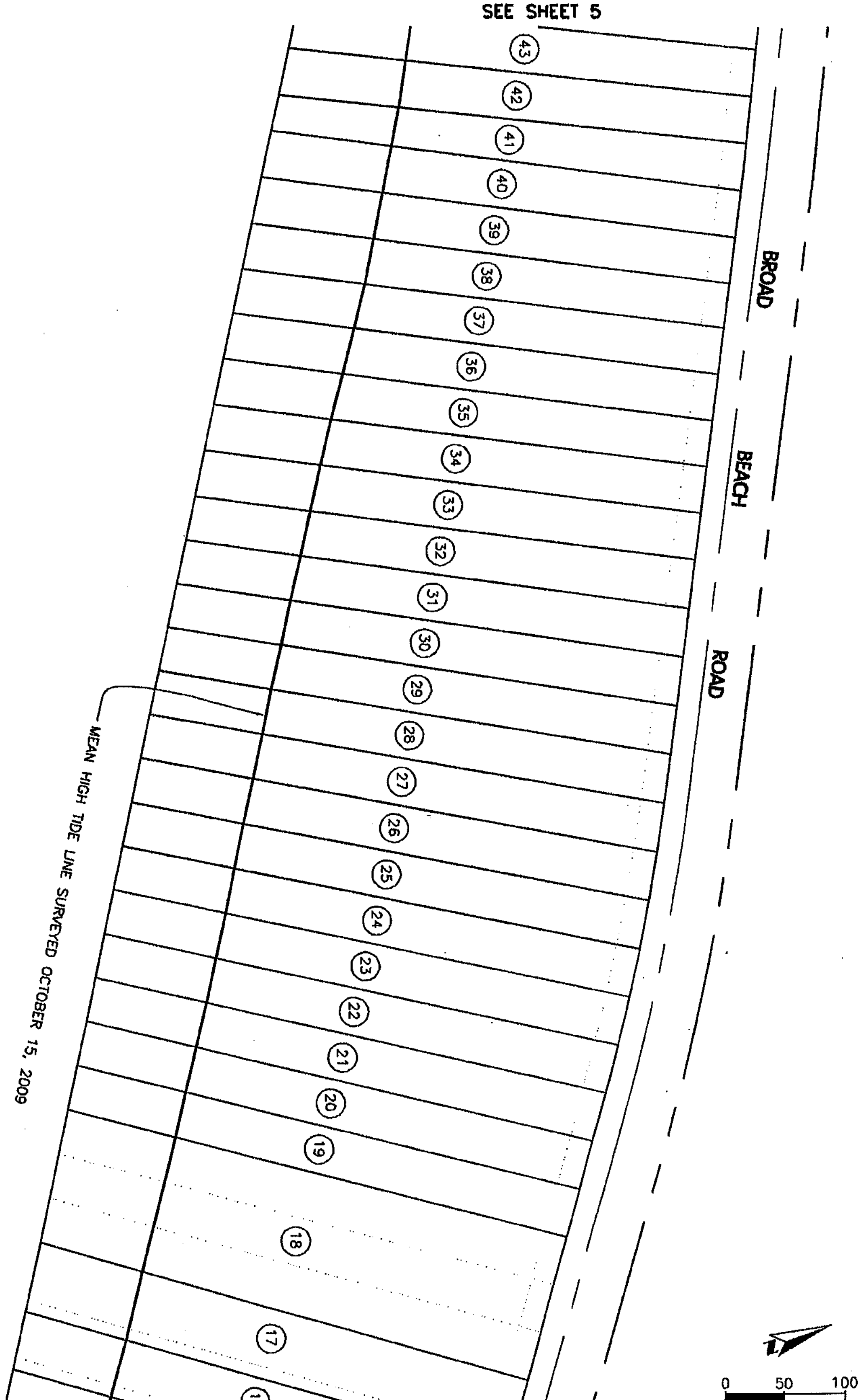
01/18/12

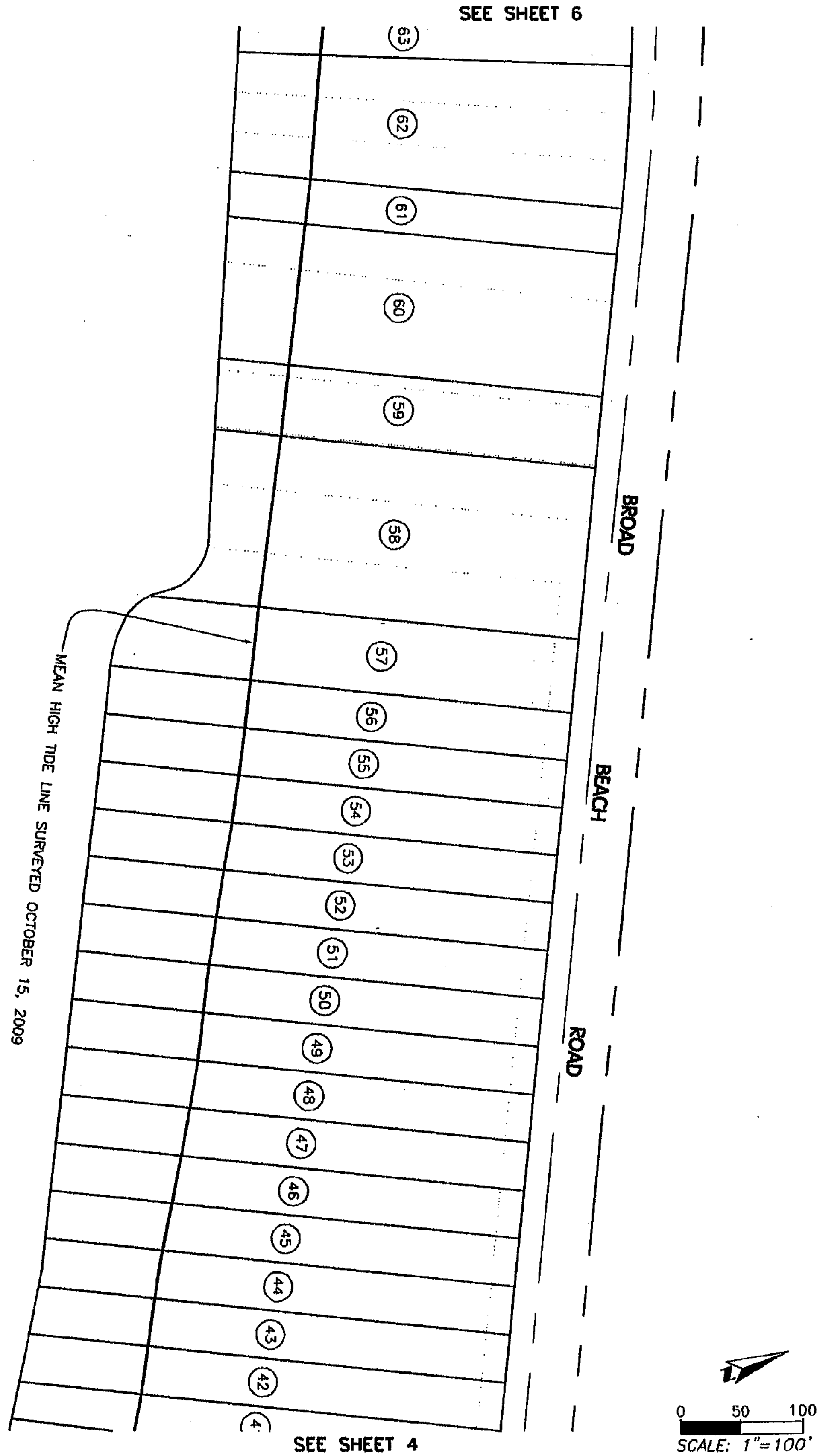
SEE SHEET 5



SEE SHEET 3

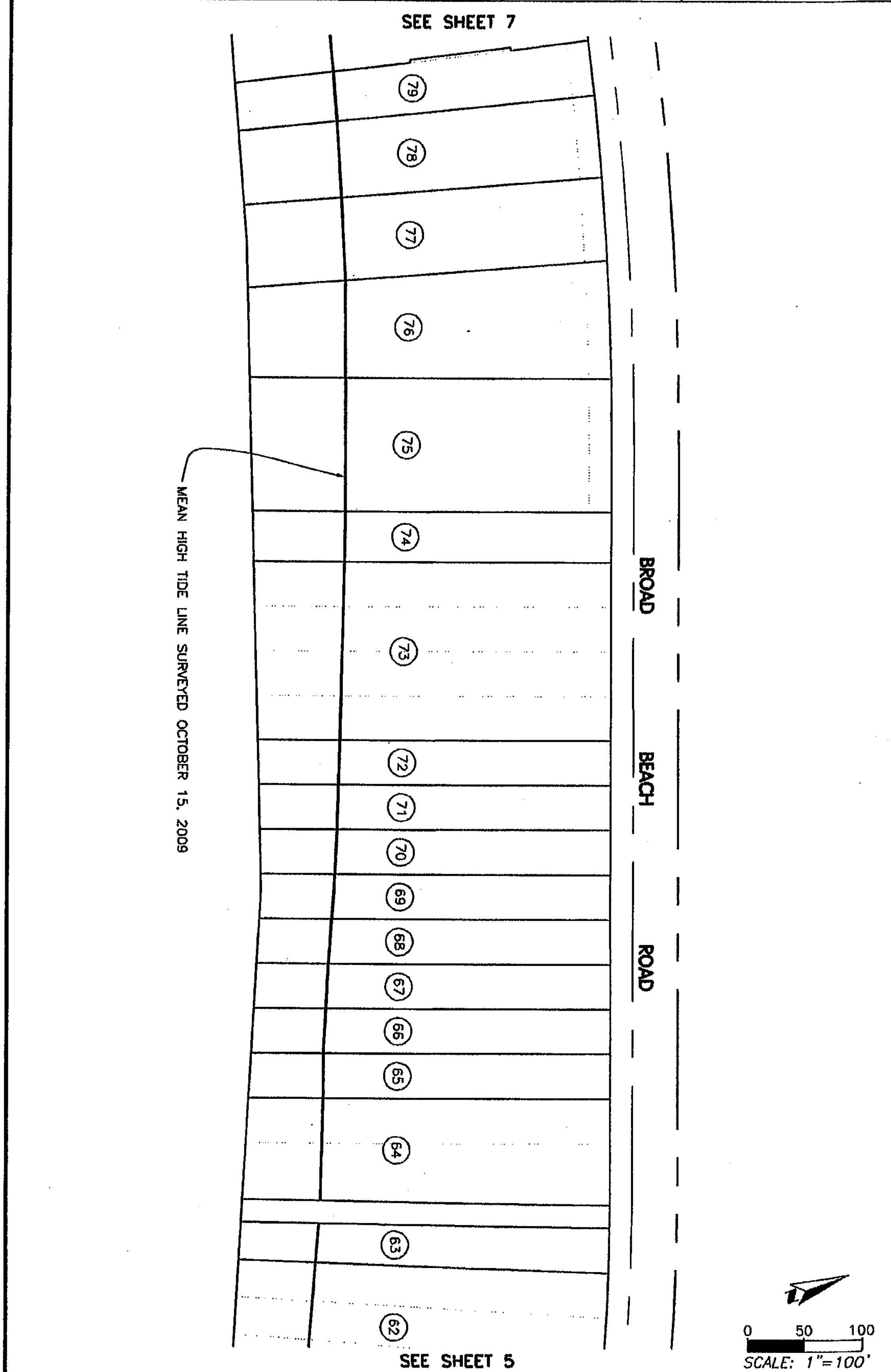
01/18/12

ASSESSMENT DIAGRAM



ASSESSMENT DIAGRAM

01/18/12



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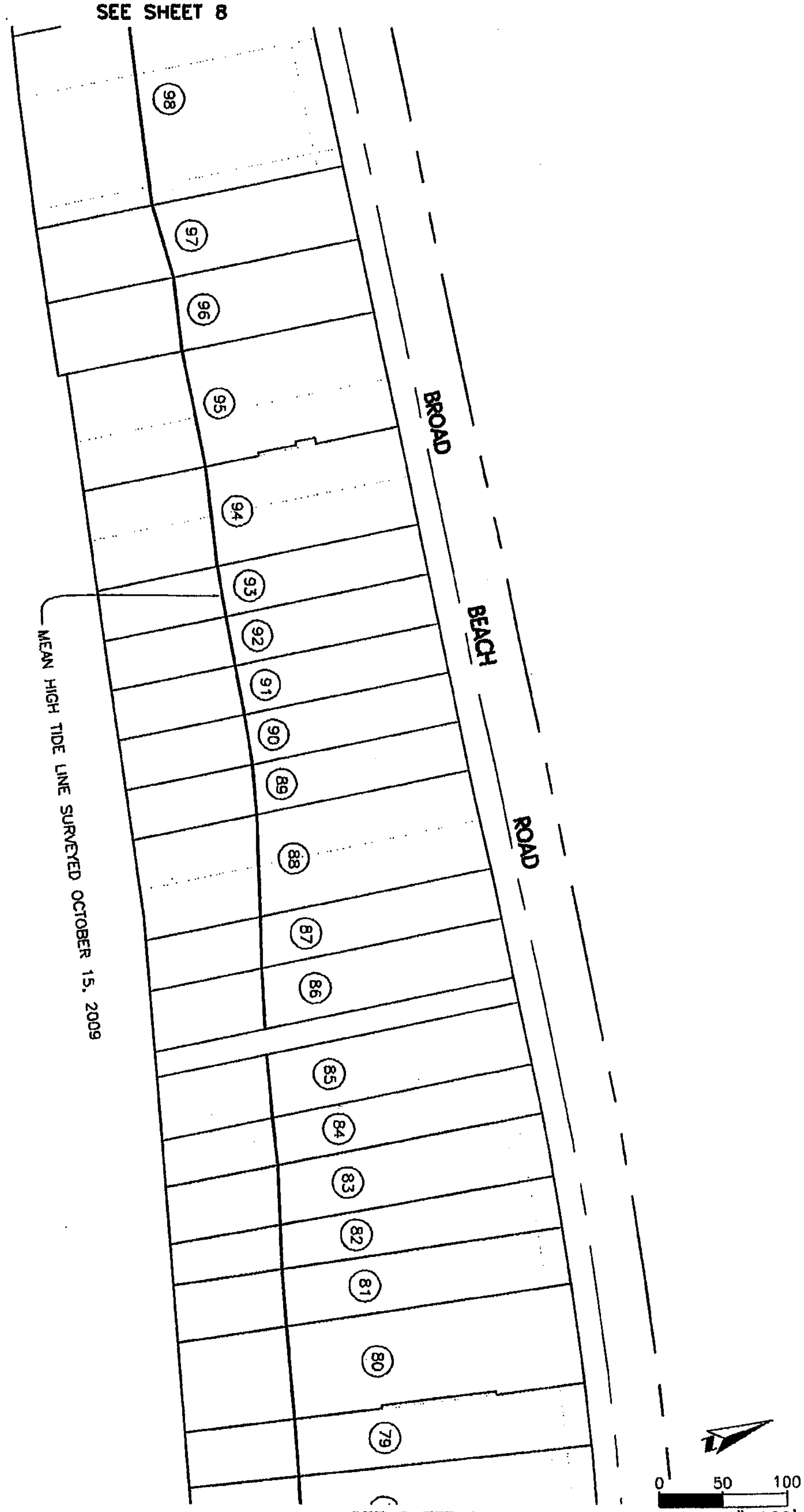
01/18/12

ASSESSMENT DIAGRAM

SEE SHEET 8



SEE SHEET 6

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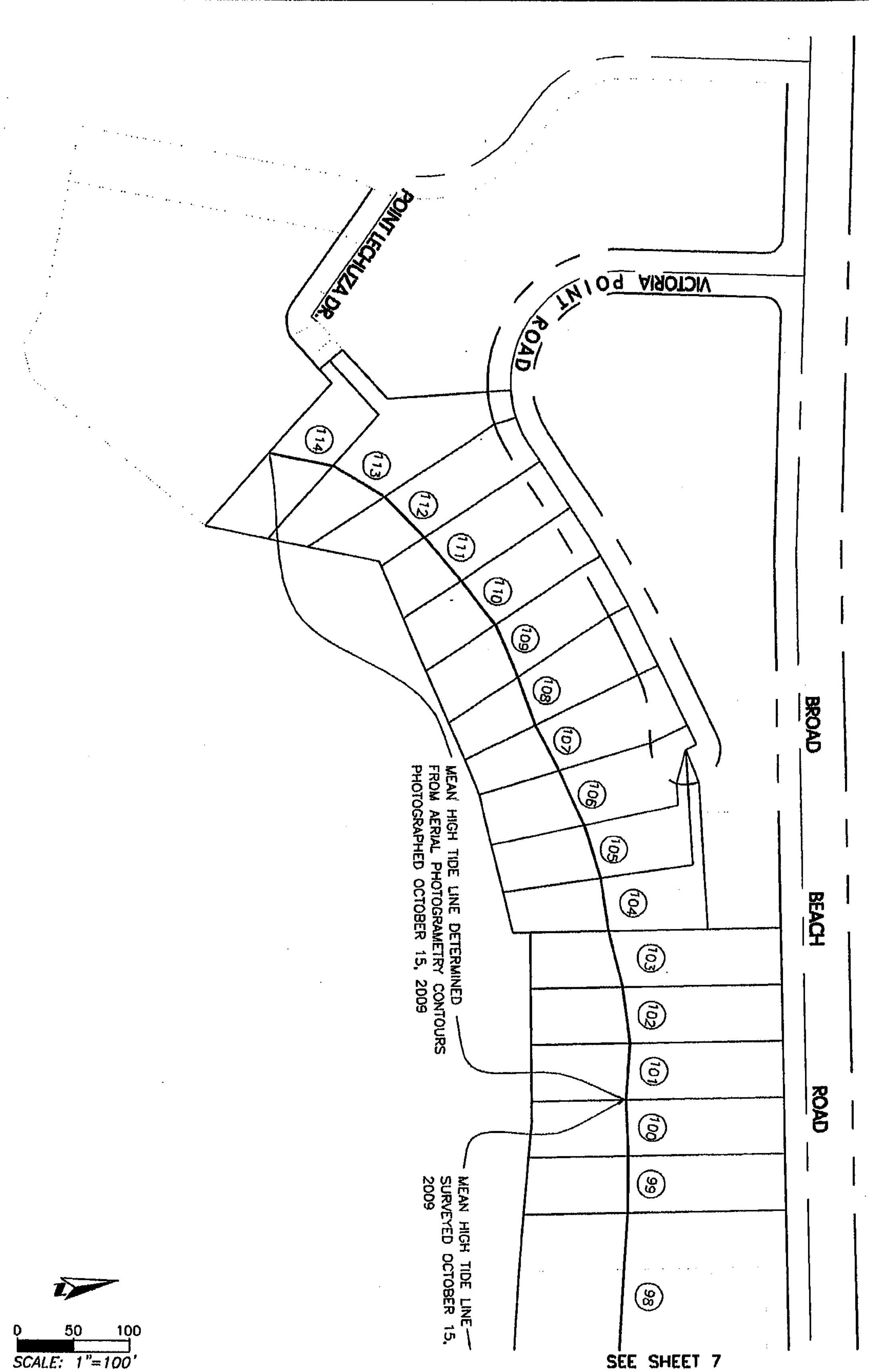
01/18/12	ASSESSMENT DIAGRAM	SHEET 8 OF 8



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