APPENDIX I

SEPTIC ANALYSIS

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BROAD BEACH RESTORATION ONSITE WASTEWATER FEASIBILITY STUDY

BROAD BEACH ROAD
MALIBU, CA

PREPARED BY:
ENSITU ENGINEERING, INC.
JOHN N YAROSLASKI
10/14/2013

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SECTION 1- EXECUTIVE SUMMARY

BACKGROUND (SEE SECTIONS 2, 3, AND 4)

Ensitu Engineering Inc., ("EEI") was asked by the Broad Beach Geologic Hazard Abatement District ("BBGHAD") to respond to California Coastal Commission's ("CCC") request that the BBGHAD study the feasibility of moving the current rock revetment as far landward as possible.

The resulting engineering work was based on current uses for the existing properties, future uses for vacant properties, current City of Malibu Local Coastal Program ("LCP") Local Implementation Plan ("LIP")[1], City of Malibu Plumbing Code[2], and Environmental Protection Agency ("EPA") standards[3][4].

The work was split into two Scenarios:

- Scenario One was to look at current on-site wastewater systems, assuming non-compliant systems would not be brought up to code, and determine the most landward location for the revetment
- Scenario Two was to see how far landward the revetment could be relocated for each property based on replacing the onsite wastewater system with the most advanced (and most land economical) systems appropriate to a beach environment, with drainfields placed as far landward as possible and irrespective of existing auxiliary buildings and landscape and hardscape, provided however that such replacement systems would still be compliant with the LCP/LIP and the City of Malibu Plumbing Code

The work also includes an evaluation of technologies and determination of the most appropriate technology for the work. Technologies evaluated were: connection to Trancas Water Pollution Control Plant ("TWPCP"), construction centralized treatment plant for entire project, waterless toilet technology, and individual on-site treatment system for each property.

EVALUATION OF TECHNOLOGY AND EQUIPMENT SELECTION (SEE SECTIONS 5 AND 6)

Connection to TWPCP was ruled out due to a documented and confirmed lack of capacity. Installation and connection to a centralized treatment plant (similar to TWPCP) was ruled out due to lack of available area to site the plant, construction impacts (installation of miles of pipe to and from the plant), and effluent distribution area (code still applies to dispersal of effluent so no net saving in area). Waterless toilet technology was ruled out due to excessive maintenance, unsanitary operation, unreliable performance, and inability to mandate properties to utilize technology. Individual on-site treatment system for each property was selected because the technology is accepted by the City, the units are maintained by certified personnel not the property owner, the unit selected is reliable and meets City effluent

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restrictions for beach front properties, and the system are mandated by the City so property owners will be required to upgrade.

CONCLUSIONS (SEE SECTIONS 7 AND 8)

SCENARIO ONE

Design scenario one resulted in the possibility of the rock revetment from 31022 Broad Beach east, to the end of BBGHAD properties, to be moved further landward.

SCENARIO TWO

Design scenario two resulted in the possibility of the rock revetment from 30918 Broad Beach east to be moved further landward.

It is our opinion that Scenario One is a short term solution and may cause unintended consequences, such as adverse effects on real estate market conditions and future permitting problems with the City of Malibu and potentially other agencies. All properties must comply with City code when they change ownership, repairs are made to existing system, or the structure is remodeled. If the rock revetment was moved landward from 31022 Broad Beach west the property owners could be limited in their ability to resell or remodel their homes. They could also face difficulty upgrading or repairing their existing on-site wastewater systems due to space restraints and code issues..

SECTION 2- OVERVIEW

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This Report, prepared by Ensitu Engineering Inc. of Morro Bay, CA, ("EEI") on behalf of the Broad Beach Geologic Hazard Abatement District ("BBGHAD"), responds to the California Coastal Commission's ("CCC") request that the BBGHAD study the feasibility of moving the current emergency-permitted rock revetment at Broad Beach as far landward as possible, regardless of the current back yard improvements and structures (temporary or permanent) existing between homes along Broad Beach Road and the emergency revetment. Since many of the subject Broad Beach homes have their septic systems between the primary residential structure and the revetment, this CCC request caused the BBGHAD to commission this report, which outlines the design, installation, and operation of theoretical, new Onsite Wastewater Treatment Systems ("OSTS") for homes located along Broad Beach Road from addresses 30760 Broad Beach Road through 31430 Broad Beach Road, Malibu, CA 90265 (**Figure 1**, page 11), including those homes located landward of the revetment from 30760 Broad Beach Road to 31346 Broad Beach Road.

Along with its appendices, references, and other submissions, this Report provides the CCC with the information necessary to investigate the feasibility of moving the revetment to a more landward location at all or part of the revetment span from 30760 Broad Beach Road through 31346 Broad Beach Road through a pullback of OSTS using readily available and accepted waste treatment technology and in accordance with applicable laws, including the Coastal Act, City of Malibu Local Coastal Plan ("LCP"), and the Malibu Land Implementation Plan ("LIP")[1].

Figure 1 Site Plan

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To most effectively demonstrate the System's ability to meet water quality objectives, the Report is structured as follows:

- Section 1 provides a report executive summary
- Section 2 provides project overview
- Section 3 provides general project data
- Section 3 provides LCP/LIP basis for OSTS design and project design values based on LCP/LIP
- Section 4 provides basis for engineering design
- Section 5 provides evaluation of technologies
- Section 6 provides Equipment selection information
- Section 7 provides design scenarios for individual lot (property) design methodology, calculations, results, and examples as well as determination of OSTS string-line and setbacks to protection device and wave up-rush
- Section 8 provides individual lot (property) OSTS installation cost methodology, calculations, results, and examples
- Section 9 provides conclusions based on Sections 2- 8
- The Appendixes provide the following:
    - OSTS Engineering Plans
    - OSTS Calculation Sheets
    - Engineering Reports Used for OSTS Design
    - Property Research Documents
    - Reference Documents

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SECTION 3- PROJECT DATA

PART 1- GENERAL DATA

1.01. Project Information and Reports

Table 1 General Data, Project Information and Reports

Project Address:	1- 30760 Broad Beach Road through 31430 Broad Beach Road, Malibu, CA 90265
Project Description:	2- Construction of Advanced Wastewater Treatment Facility and Appurtenances
Wastewater Engineer	3- Ensitu Engineering Inc. 685 Main Street, Suite A Morro Bay, CA 93442 Tel: (805) 772-0150 Contact: John Yaroslaski, PE email: jyaroslaski@ensitu.com
Civil Engineer	4- Moffatt & Nichol 3780 Kilroy Airport Way Long Beach, CA 90806 Tel: (562) 426-9551 Contact: Russell H. Boudreau, PE email: rboudreau@moffattnichol.com
Coastal Engineering Consultant:	5- Moffatt & Nichol 3780 Kilroy Airport Way Long Beach, CA 90806 Tel: (562) 426-9551 Contact: Russell H. Boudreau, PE email: rboudreau@moffattnichol.com
Local Governing Agency	6- City of Malibu
State Agency	7- California Coastal Commission ("CCC")

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SECTION 4- BASIS FOR DESIGN

PART 1- CITY OF MALIBU LOCAL COASTAL PROGRAM ("LCP") LOCAL IMPLEMENTATION PLAN ("LIP") SECTIONS 18.4, 18.7, AND 18.8

1.01. LCP, LIP Section 18.4 Permit Application and Other General Requirements[1, p. 291]

A. A CDP is required for all new OSTSs, for any expansion and modification of an existing OSTS, or for a change in the type or intensity of use of an existing system. The CDP shall not be approved unless

1. the existing or proposed septic system is consistent with the requirements contained in this Chapter, current Guidelines of the Regional Water Quality Control Board or such other requirements of the City of Malibu, whichever are more stringent, or
2. a condition is imposed on the permit that requires upgrade or redesign of the existing septic system, or construction of a new septic system, to comply with the requirements contained in this Chapter.

B. The application for a CDP for OSTS installation and expansion shall include a Site Evaluation Report (SER) prepared by a qualified professional. The SER shall contain results of soils analysis and/or percolation tests including but not limited to: soil conditions, characteristics and estimated permeability, depth of zones of saturation, depth to bedrock, surrounding geographic and topographic features, direction of ground contour and % slopes, distance to drainages, water bodies and potential for flooding. Site limitations and special characteristics shall be listed in the SER.

C. The SER prepared for OSTS installation or expansion shall also include the following information:

1. Existing uses on the site (for expansion only)
2. Existing and proposed locations of all buildings, roads, driveways, and other physical features
3. Property lines
4. Easements
5. Water sources, wells and surface water courses or drainage ways.
6. Locations for septic tank, distribution box or drop boxes, and all other system components

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7. Locations of soil treatment area and replacement area, drawn to scale.
8. Operations and maintenance instructions for OSTS components

D. The SER prepared for the following developments shall include a cumulative impact analysis evaluating the potential impact by the proposed OSTS(s) on groundwater level and quality (i.e.., effects of groundwater mounding, nitrate loading and fecal/pathogen contamination), quality of nearby surface drainages (i.e.., nitrate loading and fecal/pathogen contamination), and

1. Individual OSTS with flow of greater than 1,500 gallons per day (gpd);
2. Subdivisions;
3. OSTSs for commercial developments;
4. For any lot which involves two or more OSTSs within 100 feet of each other with a combined capacity of over 1,500 gpd;
5. OSTSs for multi-family residential developments;
6. Any “community” disposal system which includes three or more individual homes utilizing one disposal system;
7. System(s) which the City or LA RWQCB has identified as presenting a potential threat to surface water or groundwater beneficial uses; and
8. For systems within areas of known nitrate groundwater problems.

E. The minimum values used in the cumulative impact analysis for the total nitrogen concentration of septic tank effluent shall be 40 mg/L as N (for average flow conditions) for residential wastewater, or as determined from the sampling of comparable system(s) or literature values acceptable to the City. OSTSs shall not cause the groundwater nitrate-nitrogen concentration to exceed 10.0 mg/L as N at any current or potential source of drinking water on or off-site.

F. Groundwater mounding analysis (in the cumulative impact analysis) shall be used to predict the highest rise of the water table and shall account for background groundwater conditions during the wet weather season. The maximum acceptable rise of the water table under treatment systems for short periods of time during the wet weather season, as estimated from groundwater mounding analysis, shall be as follows;

1. All OSTSs: Groundwater mounding beneath the effluent dispersal system/soil absorption field shall not result in more than 50% reduction in the minimum depth to seasonably high groundwater as required under Section 18.7(G).

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2. Large Systems: Notwithstanding (F)(1), systems with design flows of 1,500 gpd or more shall have a minimum unsaturated depth of 24 inches beneath the bottom of the subsurface effluent dispersal system (for leachfield or similar systems) or beneath the natural grade (for above ground systems)

G. Development that includes new OSTS(s) or expansion of existing OSTS(s) shall also include the installation of low-flow plumbing fixtures, including but not limited to flowrestricted showers and ultra-low flush toilets, and, where feasible, the elimination of garbage disposals to avoid hydraulic overloading of the OSTS.

H. Where feasible, development that includes new OSTS(s) or expansion of existing OSTS(s) shall divert graywater such as washing machine and bath/shower wastewater from the septic system for separate treatment and/or reuse on site.

I. The construction dimensions of the sewage effluent dispersal system (soil absorption field) of an OSTS shall be based on soils analysis and/or percolation tests. Soils analysis shall be conducted by a California Registered Geotechnical Engineer or a California Registered Civil Engineer in the environmental/geotechnical field and the results expressed in United States Department of Agriculture classification terminology. Percolation tests shall be conducted by a California Registered Geologist, a California Registered Geotechnical Engineer, a California Registered Civil Engineer, or a California Registered Environmental Health Specialist.

J. A valid Standard Operating Permit (SOP) or Renewable Operating Permit (ROP) shall be required for all new, modified, and expanded OSTSs. A SOP shall be issued for standard OSTSs for single-family residences in areas of low environmental sensitivity. A ROP shall be issued for:

1. Systems for commercial and multi-family residential developments.
2. Alternative/enhanced treatment systems.
3. Performance-based systems required to achieve specific water quality criteria.

K. The City shall determine the length of time that a ROP shall remain in effect by one or more of the following considerations:

1. System complexity
2. Public health concerns
3. Environmental concerns

L. The City shall not issue an operating permit until the as-built plans and the operations and maintenance instructions are submitted and the final

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inspection and testing of the system has been performed. The plans showing placement of soil absorption systems shall be kept on file in City offices.

M. The operating permit shall include all applicable monitoring, operation and maintenance requirements contained in this Chapter and all applicable regulations.

N. The ROP shall further require that maintenance contracts with qualified service providers be established and remain in effect. In addition, the City shall only renew a ROP after a satisfactory compliance inspection. The City shall require any corrections necessary to bring the OSTS into compliance with all applicable regulations. Failure to make the corrections within thirty days after written notification or posting of a correction notice at the site shall result in a violation of the permit process and the issuance of a violation notice by the City.

O. All OSTSs shall be designed, sited, installed, operated, and maintained in full compliance with the requirements contained in this LCP.

1.02. LCP, LIP Section 18.7. Siting, Design And Performance Requirements[1, p. 296]

A. Onsite Wastewater Treatment System ("OSTS") shall be located above the ten-year floodplain and be protected from standing water to the maximum extent feasible.

B. The construction dimensions of the sewage effluent dispersal area (soil absorption field) of an OSTS shall be based on soils analysis and/or percolation tests. Soils analysis shall be conducted by a California Registered Geotechnical Engineer or a California Registered Civil Engineer in the environmental/geotechnical field and the results expressed in United States Department of Agriculture classification terminology. Percolation tests shall be conducted by a California Registered Geologist, a California Registered Geotechnical Engineer, a California Registered Civil Engineer, or a California Registered Environmental Health Specialist.

C. Septic tank and leach area systems shall be used only where the proposed site can maintain subsurface disposal. When a percolation test is required, no standard OSTS shall be permitted to serve a new development or redevelopment if that test shows the absorption capacity of the soil is less than 0.83 gallons per square foot (33.8 L/m) per 24 hours.

D. The proposed site for subsurface sewage effluent dispersal system/soil absorption system shall also be free from poorly drained soils and soils or formations containing continuous channels, cracks, or fractures, unless a setback of 250 ft. to domestic water supply well or surface water

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is assured, or unless secondary or tertiary wastewater pre-treatment is provided prior to discharging to the system.

E. Under no circumstances shall construction of new cesspools be allowed.

F. Use of treated OSTS effluent for above-surface irrigation, as an alternative to subsurface treatment, shall require the design and operation approval by the Executive Officer of the Regional Board and/or any other applicable permitting authorities.

G. Depth from the bottom of the effluent dispersal system to groundwater shall be based upon percolation rate, but no less than 5 feet. Groundwater shall be defined as the highest seasonal level of the permanent water table in the soil.

H. Seepage pits shall be used only where distances between pit bottom and groundwater is equal to or greater than the following minimum separations, based on soil type:

   1. 50 ft (Gravels – soils with over 95% by weight coarser than a No. 200 sieve and over half of the coarse fraction larger than a No. 4 sieve.)
   2. 20 ft (Gravels with few fines – soils with 90% to 94% coarse fraction larger than a No. 4 sieve.)
   3. 10 ft (Other)

I. Standard systems shall not be placed on soils having percolation rates above 60 minutes per inch (mpi) or below 5 mpi. Enhanced treatment/alternative systems offering secondary or tertiary effluent treatment prior to discharging to any subsurface sewage effluent dispersal system shall be used instead.

J. Beachfront development that includes new OSTS(s) or expansion of existing OSTS(s) shall provide secondary or tertiary effluent treatment prior to discharging to any subsurface sewage effluent dispersal.

K. Siting of soil absorption fields/effluent dispersal systems on slopes greater than 10% shall be evaluated to assess possible impacts of lateral migration of effluent. The evaluation results shall be included in the SER. No soil absorption fields shall be located on slopes greater than 45%. Conventional gravity trench leachfields shall not be installed on slopes greater than 30%. Soil absorption fields located on slopes between 30 and 45% shall be designed to address critical factors of soil depth, restrictive horizons, soil permeability, application rates and disposal methods. The soil shall have a minimum effective depth of six feet with no evidence of seasonal saturation.

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L. Where a cumulative impact analysis has been performed as required in this Chapter, OSTS installation or expansion shall be allowed only if all of the following are true:

1. OSTS will not cause the groundwater nitrate-nitrogen concentration to exceed 10.0 mg/L as N at any current or potential source of drinking water on or off-site; and

2. The maximum acceptable rise of the water table under treatment systems for short periods of time during the wet weather season, as estimated from groundwater mounding analysis, shall be as follows:

   a. All OSTS: Groundwater mounding beneath the effluent dispersal system/soil absorption field shall not result in more than 50% reduction in the minimum depth to seasonably high groundwater as required under Section 18.7 (G); and
   b. Large Systems: Notwithstanding the above, systems with design flows of 1,500 gpd or more shall have a minimum unsaturated depth of 24 inches beneath the bottom of the subsurface effluent dispersal system (for leachfield or similar systems) or beneath the natural grade (for above ground systems).

M. All OSTS on new developments and redevelopments shall comply with the following horizontal setbacks (in feet):

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Table 2 LCP, LIP Section 18.7.M OSTS Horizontal Setbacks

Min. Horizontal Setback From:	Septic Tank	Horizontal Effluent	Vertical Effluent Dispersal System
8- Buildings or structures	5	8	8
9- Property line	5	5	8
10- Water supply wells	150	150	150
11- Perennial streams	100	100	100
12- Intermittent/ephemeral streams	100	100	100
13- Springs or seeps	50	50	100
14- Ocean/Lakes/Reservoirs[1]	50	100	100
15- Upgradient groundwater interceptor	20	20	20
16- Downgradient groundwater interceptor	25	50	50
17- Storm drainage pipe[2]	5	50	50
18- Fill / Cut bank[3]	10	4 x Height	4 x Height
19- Trees	10	N/A	10
20- On-site domestic water service line	5	5	5
21- Distribution box	N/A	5	5
22- Pressure public water main	10	10	10

1 Systems that provide secondary or tertiary effluent treatment prior to discharge to the subsurface effluent dispersal systems are not required to meet these minimum horizontal setback requirements provided that no parts of the OSTS are, at any time, submerged or exposed to direct contact with these surface water bodies. In the case of beachfront developments and redevelopments, the OSTS shall, to the maximum extent feasible, be located at the farthest point from the Ocean on a parcel to avoid the construction of protective structures such as sea walls and bulkheads.

2 Where publicly owned storm drainage pipes run across a property rendering it impossible to meet these minimum horizontal setback requirements, the effluent dispersal system is allowed to be located within 50 feet of the pipes provided that these pipes are positioned vertically higher than the bottom of the effluent dispersal system or the applicant demonstrates that the pipes are sealed so that there is no possibility for shallow groundwater to infiltrate the storm drain.

3 Where a California Registered Geologist finds and states in writing that the stability of the fill or cut bank will not be compromised by a shorter horizontal separation and that a shorter horizontal separation will not result in sewage effluent daylighting, a shorter horizontal setback for the effluent dispersal system can be used per the said geologist's recommendation.

N. Design flows shall be estimated by one of two methods: by number of bedrooms for the proposed dwelling or by estimating the treatment capacity of the soil treatment area/soil absorption field in gallons per day per square foot (“gpd/sf”). In sizing by number of bedrooms the designer shall use a minimum of 300 gallons per day per bedroom (“gpd/bdrm”) or 120 gpd/bdrm for low-flow fixtures. The dwelling shall be designed not to exceed the maximum number of fixture units or number of bedrooms than can be supported by the estimated maximum daily flow. For commercial developments, the design flows shall be based on the estimated waste/sewage flow rates for the various commercial uses identified in Table K-3 of the City of Malibu’s Uniform Plumbing Code, 1997 Edition, as amended in 2000.

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O. All systems shall comply with the following application rates according to the different soil textures:

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Table 3 LCP, LIP Section 18.7.O OSTS Dispersal Application Rates

Soil Texture	Structure	Application Rate (gpd/sf)
Gravelly coarse sand & coarser	Loose or cemented	0.0
Clay, sandy or silty clay silt loam	Weak or massive Massive	0.0 0.0
Sandy clay loam, clay loam or silty clay loam	Massive	0.0
Sandy clay, clay or silty clay	Moderate to strong	0.2
Sandy clay loam, clay loam or silty clay	Weak	0.2
Sandy clay loam, clay loam or silty clay loam	Moderate to strong	0.4
Sandy loam, loam or silt loam	Weak	0.4
Sandy loam, loam or silt loam	Moderate to strong	0.6
Fine, very fine, loamy fine and very loamy fine sand	Not Applicable	0.8
Coarse, single grain sand	Not Applicable	1.2

Table 4 LCP, LIP Section 18.4.E and 18.7.J Treatment System Performance Standards

Constituent	Unit	Monthly Average
Total Suspended Solids (TSS)	mg/L	30
Biochemical Oxygen Demand	mg/L	30
Nitrate as N (in groundwater)	mg/L	10
Total Coliform	mpn/100mL	23

P. Septic tanks shall be designed to provide a minimum retention time of at least 24 hours, with one-half to two-thirds of the tank volume reserved for sludge and scum accumulation. The appropriate septic tank capacity shall conform to requirements contained in Table K-2 of the City of Malibu's Uniform Plumbing Code, 1997 Edition, as amended in 2000.

Q. There shall be a minimum of 100% reserve area set aside for replacement of the soil absorption field. The backup field shall be capable of accommodating the entire wastewater flow.

R. No soil absorption fields/subsurface effluent dispersal systems shall be allowed beneath nonporous paving or surface covering.

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S. Soils in the designated soil absorption field shall not be compacted during construction and post construction of new developments and redevelopments. Construction vehicles shall be restricted from entering the designated soil absorption field area. Septic owners shall not place buildings, livestock, impervious materials, equipment, parking areas, or driveways over the soil absorption area. Surface and subsurface soils in these areas shall not be removed, ripped, contoured or compacted.

1.03. LCP, LIP Section 18.8. Alternative Systems[1, p. 301]

A. Alternative systems are defined as any system other than a standard system. They shall be used on parcels where site and soil conditions will not support a standard system or where increased treatment is needed. They are generally characterized as having increased design and performance criteria.

B. Alternative systems shall be designed by a California Registered Geologist, California Registered Geotechnical Engineer, California Registered Civil Engineer or a California Registered Environmental Health Specialist.

C. Alternative systems shall be reviewed on a case-by-case basis. Their use shall be combined with a reasonable testing and monitoring protocol subject to approval by the Executive Officer of the Regional Board. Alternative systems shall be tested and evaluated for a minimum of three years. The owner of the system shall be responsible for the performance, operation and evaluation of the system for the first five years. Thereafter, the owner shall assume responsibility for repair and/or replacement should the system fail to perform in accordance with applicable requirements contained in the operating permit, this LCP and any other pertinent regulations.

D. Package wastewater treatment plants shall only be used on parcels where site and soil conditions will not support a standard system and other alternative systems or where it can be demonstrated that a package treatment plant would have fewer adverse impacts to coastal resources, water quality or geology stability than traditional or other alternative systems. Package treatment plants shall be designed by a California Registered Civil Engineer.

E. Package wastewater treatment plants shall be reviewed on a case-by-case basis. Their use shall only be considered when combined with a reasonable testing and monitoring protocol subject to approval by the Executive Officer of the Regional Board. Package wastewater treatment plants shall be tested and evaluated for a minimum of three years. The owner of the system shall be responsible for the performance, operation

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and evaluation of the system for the first five years. Thereafter, the owner shall obtain a Renewable Operating Permit from the City and assume responsibility for repair and/or replacement should the system fail to perform in accordance with applicable requirements contained in the operating permit, this LCP and any other pertinent regulations.

F. The construction of public package wastewater treatment facilities may be permitted where it is demonstrated to be the preferable long-term wastewater management solution, where it is designed to not exceed the capacity for growth allowed in the LCP, and where it can be constructed consistent with all requirements of this LCP and all applicable regulations.

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PART 2- NUMERIC OSTS DESIGN MINIMUMS

2.01. Minimum Design Parameters

Table 5 OSTS Minimum Design Parameters

Description	Unit	Value	LCP LIP Section
23- OSTS Design Flow	Gallons per day per bedroom ("gpd/bdrm")	300	18.7.M
24- OSTS Dispersal Application Rate	gallons per square foot per day ("gpd/sf")	1.2	18.7.O
25- Treatment Manufacturer Used	MicroSepTec		
26- Treatment Unit ES6	gpd	600	
27- Treatment Unit ES12	gpd	1200	
28- Treatment Unit ES25	gpd	2500	
29- Minimum Dispersal Field Setback to Structures	ft	8	18.7.M
30- Minimum Treatment Tank Setback to Structures	ft	5	18.7.M
31- Minimum Dispersal Field Setback to Property Lines	ft	5	18.7.M
32- Minimum Treatment Tank Setback to Property Lines	ft	5	18.7.M
33- Minimum Dispersal Field Setback to Broad Beach Road Easement	ft	0	
34- Minimum Treatment Tank Setback to Broad Beach Road Easement	ft	0	
35- Minimum OSTS Setback to Wave-Uprush Line	ft	15	
36- Minimum Setback to OSTS protection Device	ft	5	

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SECTION 5- TECHNOLOGY EVALUATION

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EEI evaluated several options for technology based solutions to the design scenarios. These solutions included; connection to the Topanga Water Pollution Control Plant owned and operated by Los Angeles County, design and construction of a privately owned wastewater treatment facility for Broad Beach, individual OSTS on each property, and flow reduction devices.

Of the four options the only viable option was design and construction of individual OSTS on each property.

This section provides detail of each option as well as evaluation of each option.

1.01. Technology Options

A. The following technologies were considered for this project:

1. Connection to TWPCP[5]
2. Centralized Package Plant
3. Individual OSTS
4. Flow Reduction Devices

1.02. Connection to TWPCP

A connection to Trancas Water Pollution Control Plant ("TWPCP") was investigated and responded to by County of Los Angeles [5]. The TWPCP does not have capacity to handle the additional wastewater nor does it have additional area to add onto the existing system.

1.03. Centralized package Plant

A centralized package plant was considered for this project but was not feasible for several reasons:

A. Lack of available area for plant siting

Broad Beach Road does not have any available properties for placement of the Package Plant. The plant would consist of several large underground tanks in excess of 25,000 gallons each, as well as an equipment structure. There are currently no feasible areas for this type of equipment.

We are also concerned about piping raw wastewater from each property to a central location. The pipe would be vulnerable and have more potential for a large spill, if ruptured, than with individual systems.

B. Lack of area for dispersal of effluent

Effluent would need to be dispersed on the site and would be required to meet the same setback requirements as described in Section 3. This

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would involve piping raw wastewater from each property to a central location and piping treated water from the central location back to each property for dispersal

C. Cost

The cost of piping both untreated and treated wastewater from each property to the central location and back would involve excavation of Broad Beach Road, import of pipe bedding material, and possible relocation of waterlines and utility lines. This approach would also require re-plumbing of each property and connection to the raw wastewater piping, and reconstruction and repiping to each of the dispersal areas.

1.04. Individual OSTS

Individual OSTS was considered for this project and considered the most feasible for several reasons:

A. All properties have area for treatment and disposal

Onsite treatment and disposal allows for short runs of piping and individual control of systems therefore less potential for large spills of contamination due to system upset

B. All properties have area for effluent dispersal

Effluent dispersal on each property can be designed to meet all setback requirements, assuming proper placement of revetment.

C. Cost

The properties already have piping to current systems and from current systems to dispersal. The only additional costs would be relocation of system impacted by wave uprush setbacks or relocation based on this report.

1.05. Flow Reduction Devices

Flow reduction devices such as incinerating toilets and addition of low-flow fixtures were considered for this project but were not feasible for several reasons:

A. Incinerating Toilets [6][7] were deemed not feasible due to operational constraints of the unit (can only be used every 60 minutes) maintenance problems (for example buildup of partially burned feces in bowl), odor, smoke, and high power consumption.

1. Description

Incinerating toilets are self-contained units consisting of a traditional commode-type seat connected to a holding tank and a gas-fired or

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electric heating system to incinerate waste products deposited in the holding tank. The incineration products are primarily water and a fine, nonhazardous ash that can be disposed of easily and without infection hazard (see Figure 2, page 30).

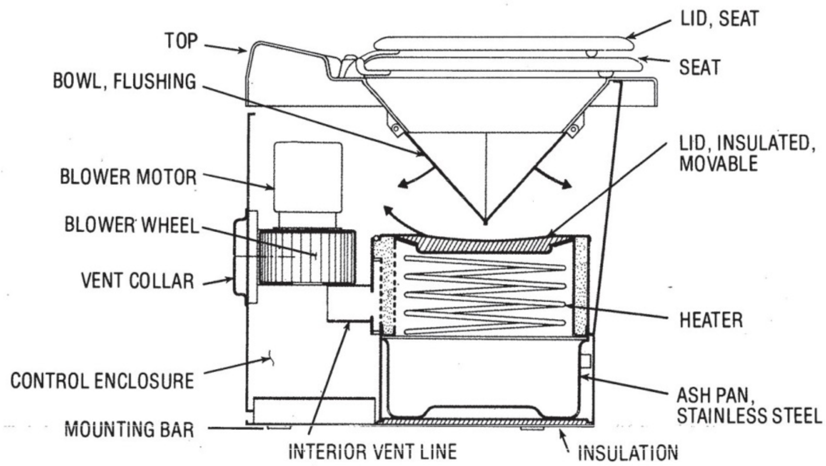

Figure 2 Incinerating Toilet Schematic

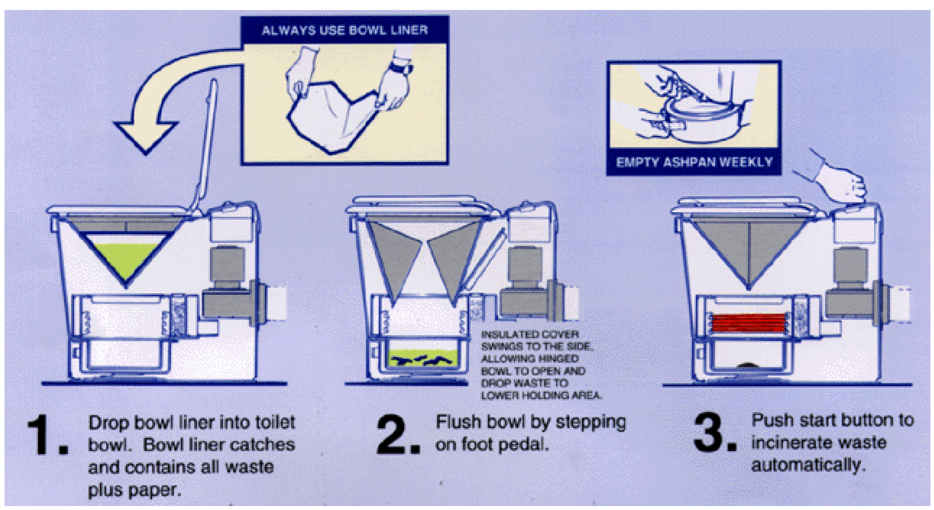

Figure 3 Incinerating toilet operation

2. Electric Incinerating Toilets

The Incinolet electric incinerating toilet (Blankenship/Research Products, 1999) is designed with a paper-lined upper bowl that collects newly deposited waste. To "flush," a foot pedal is pressed causing an insulated chamber cover to lift and swing to the side while the bowl halves separate, dropping the paper liner and its contents

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into the chamber. When the foot pedal is released, the chamber is resealed and the bowl halves return to normal position.

Incineration is initiated by pressing a "start" button after each use of the toilet (see Figure 3, page 30). The manufacturer does not recommend using the toilet multiple times between incineration cycles. The toilet can continue to be used while incineration is in progress. Once the "start" button is pressed, an electric heating unit cycles on-and-off for 60 minutes while a blower motor draws air from the chamber over a heat activated catalyst bed designed to remove odor components. Upon leaving the catalyst bed, the air is forced out through a vent line. Makeup air for the chamber is drawn from the room in which the toilet is operating. The blower motor continues to operate after the heating cycle to cool the unit. A complete cycle takes from 1.5 to 1.75 hours.

Five models of the Incinolet electric toilet are available: two for fixed locations (one four-person capacity and one eight-person capacity); two mobile- location units for motor homes, trailers and boats (one four-person and one eight-person); and a urinal (eight-person). The smaller capacity units are designed for 120 volt service, while the larger units require 240 volts. All models retain the same fundamental design principles described above.

3. Performance

"Evaluation of 19 On-Site Waste Treatment Systems in Southeastern Kentucky." A comparative "blackwater" (human excrement waste) treatment study, known as the Appalachian Environmental Health Demonstration Project (AEHDP), was conducted in southeastern Kentucky during the 1970s (U.S. EPA 1980.) As part of the year study, twenty prototype systems representing several alternative treatment technologies were installed in private residences in southeastern Kentucky during 1970 and 1971, including six incinerating toilets. The region used for the study was mountainous, characterized by shallow soils, steep slopes and high groundwater, having a demonstrated need for alternative treatment methods. Further, the study was performed in a low-income area where cost of installation and operation was a critical consideration.

Two of the six toilets used in the study were Incinolet brand units and the remaining four were Destroilet brand propane-fired toilets. Since the Destroilet is no longer on the market, and was significantly different in design from propane-fired toilets available today,

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findings related to the Destroilet are not relevant. Results pertaining to the Incinolet electric toilet, however, are still pertinent.

The two users of Incinolet toilets complained of incomplete waste incineration. Scraping of partly burned feces from the walls of the incinerating chamber was periodically necessary. One household using the Incinolet deemed the operating cost excessive, and abandoned the incinerating toilet in favor of their outdoor privy after approximately six months. The second household used the Incinolet for approximately three years; however, toilet use was intermittent over this period and the outdoor privy was preferred because of incomplete incineration of waste products. The second household installed a septic system to replace both the Incinolet and the privy. The study acknowledges that the Incinolet manufacturer subsequently added catalyst as an incineration aid, but notes that the basic configuration of the unit was unchanged.

4. Operation and Maintenance (see Figure 4, page 33)

Incinerating toilets require ongoing maintenance including; regular emptying of the ash collection pan (byproduct of incineration), cleaning of the outer stainless steel surfaces including the bowl halves, periodic (every 90 days) cleaning of the blower motor with occasional replacement of the blower wheel, cleaning and lubrication of the foot pedal mechanism, removal of bits of paper and dust from the combustion chamber, annual inspection of the catalyst.

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CARE AND CLEANING

Keep your INCINOLET clean to prevent odors.

- Empty ashpan when ash is about 1/2 inch deep. EXCESSIVE ASH BUILD-UP CAUSES ODOR, SHORTENS HEATER LIFE, AND DECREASES EFFICIENCY. If ash is caked and hard to remove, just soak insert pan for a few minutes in warm water.
- Wipe up urine spills as they happen.
- Every 6 months – clean blower wheel and inside of INCINOLET.
  1. Unplug unit and remove top. (See instructions below.)
  2. Clean inside with a detergent or a spray cleaner such as Formula 409. (Do not use pine oil cleaners.)
  3. Remove blower wheel and clean. (See page 10.)
  4. DO NOT STEAM CLEAN.
  5. Stainless steel polish can be used on outside surfaces to keep INCINOLET's finish lustrous.

TIP: If blower becomes noisy or vibrates, clean or replace blower wheel. (See page 10.)

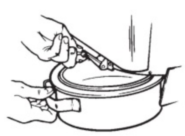
Bowl Liners

BE SURE that the top edges of the liner are below the lid when it closes. Otherwise, paper will burn outside the chamber and cause momentary smoke and odor. CAUTION: Failure to use bowl liner for each and every use will always cause odor and urine on the floor.

Bowl liners are made of a special paper coated with polyethylene film. This liner is necessary to catch and contain the waste, then convey it into the incineration chamber. USE A BOWL LINER FOR EACH AND EVERY USE. Liner protects the bowl and prevents urine from draining to the floor.

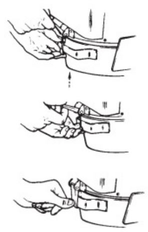
How to Remove Ashpan

Remove ashpan only when pan is cool and toilet is not operating.



TO REMOVE ASHPAN
Remove ashpan panel. Raise camloc handle and unhook it from ashpan handle. Pull ashpan out. Empty ash in garbage.

CAUTION: ASHPAN MUST BE SECURELY IN PLACE FOR PROPER OPERATION.



TO REPLACE ASHPAN
Push ashpan firmly into place.

Lift up on ashpan handle and engage hook of camloc under ashpan handle.

Push down on camloc handle. Replace ashpan panel.

Figure 4 Care and Cleaning of Incinerating Toilet (see Appendix XX for complete manual)

B. Composting Toilets[8][9] were deemed not feasible due to operational constraints and maintenance issues of the unit.

1. Description

Although there are many different composting toilet designs that continue to evolve, the basic concept of composting remains the same.

The primary objective of composting toilet systems is to contain, immobilize, or destroy pathogens, thereby reducing the risk of human infection to acceptable levels without contaminating the environment or negatively affecting the life of its inhabitants. This should be accomplished in a manner that is consistent with good sanitation (minimizing the availability of excrement to disease vectors, such as flies, and minimizing human contact with unprocessed excrement), thus producing an inoffensive and reasonably dry end-product that can be handled with minimum risk.

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A composting toilet is a well-ventilated container that provides the optimum environment for unsaturated, but moist, human excrement for biological and physical decomposition under sanitary, controlled aerobic conditions. Some are large units that require a basement for installation. Others (like the SunMar Excel unit) are small self-contained appliances that sit on the floor in the bathroom. In the composting process, organic matter is transformed by naturally occurring bacteria and fungi that break down the excrement into an oxidized, humus-like end product. These organisms thrive by aeration, without the need for water or chemicals. Various process controls manage environmental factors—air, heat, moisture—to optimize the process.

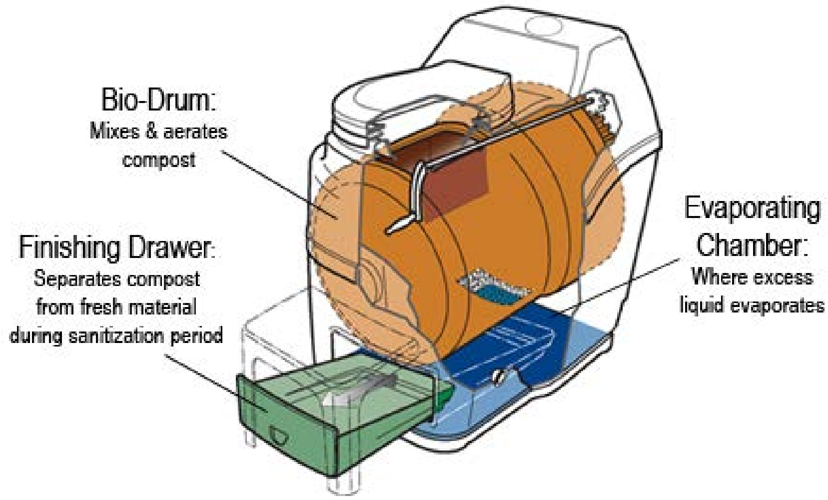

Figure 5 Composting Toilet Schematic [9, p. 3]

2. Operation

For ongoing operation of a composting toilet, the owner must add Compost Sure as specified in the product instruction manual. Rotate the drum 5 or 6 full revolutions, every 2-3 days when in use.

When the Bio-Drum™ is half to 2/3 full, the owner will need to move some of the compost to the finishing drawer by releasing the drum lock and rotating the drum backwards. This quick clean process causes the finished compost to drop into the finishing drawer.

The compost should be left for at least 4 weeks so it can finish and sanitize. In the finishing drawer, it will be isolated from contamination by fresh material in the toilet. Once 4 weeks have passed, the owner can remove the finished compost from the finishing drawer at any time

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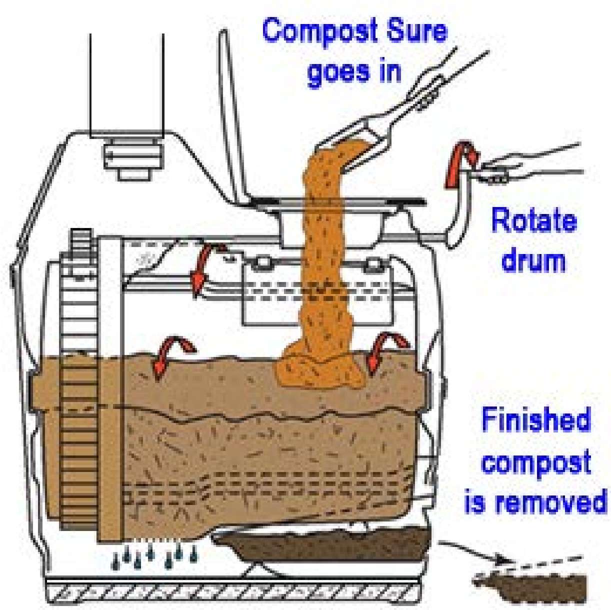

Figure 6 Operation of Composting Toilet

3. Maintenance

Composting toilets require continuous maintenance. The owner must; rake out evaporation chamber (the area below the finishing drawer), clean the drum screen (by removing the bowl liner and lift the toilet seat then turning the handle to bring the drum screen to the top of the drum then spray the drum screen to loosen the debris if the screen is not too encrusted, then scrub the screen vigorously with a the wire brush).

SECTION 6- EQUIPMENT SELECTION

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1.01. Equipment Selected by EEI

A. EEI selected MicroSepTec, EnviroServer ES as our basis for design. The unit comes in three sizes:

1. ES6 treats less than 600 gallons per day
2. ES12 treats less than 1200 gallons per day
3. ES25 treats less than 2500 gallons per day

B. The ES unit has been used in Malibu for the past 10+ years, the unit consistently meets Malibu's standard for tertiary treated wastewater, as well as EPA TS3-Tertiary Treatment standard described below. The ES unit can also be installed under driveway and meet fire department requirements for structural integrity saving valuable space.

1.02. Basis of Selection

A. Technology was selected based on several factors:

1. Performance
2. Reliability
3. Acceptance by local agencies
4. Site Constraints

1.03. Performance

A. The US Environmental Protection Agency prepared an Onsite Wastewater Treatment System Manual ("OWTSM")[3], outlining proposed onsite system performance in various control zones.

B. OSTS performance is based on EPA performance and treatment standards and should meet a minimum TS3 level. TS3 is determined based on the following:

1. Control Zone:
   a. Water Resource R3: Primary Recreational, Beaches used for Swimming, High Vulnerability Rating
   b. Control Zones determined as shown on OWSTM Chapter 3, Table 3-26, p. 3-46 (see Table 6, page 38)
2. Performance Standard:
   a. Treatment Performance Standard TS3: Control Zone R3 and separation to seasonal groundwater possibly between 2-3 feet
   b. Performance Standard determined as shown on OWSTM Chapter 3, Table 3-28, p. 3-48 (see Table 7, page 39)

3. Numeric Performance Standard:
    a. Numeric Performance Standard TS3 – Tertiary Treatment
    b. Numeric Performance Standard determined as shown on OWSTM Chapter 3, Table 3-27, p. 3-48 (see Table 8, page 39)

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Table 6 EPA Table 3-26 Resource Listing, Value Ranking, and Wastewater Management Schematic

Table 3-26. Resource listing, value ranking, and wastewater management schematic

		Water supply		Water resource					
		Ground water		GW	Surface water				GW
		Site	Critical area	Regionally important aquifer	Primary recreation	Shellfish waters	Nutrient-sensitive	Secondary recreation	Poor aquifer
		Directly next to wellfield	Wellfield capture zone	Outwash sand & gravel	Beaches used for swimming	Commercial open waters	Lakes, ponds, rivers, etc.	Other surface waters	Unproductive confined aquifers
		Sites of community wellfields and source areas within 10 days' time of travel in the ground water to the community wellfields	Inner and outer critical areas that are within the ground water capture zones for the community wellfields	High-yielding surficial aquifers of regional importance that are used for many individual wells and that have rapid recharge	Source areas within 200 feet of frequently used swimming beaches	Source areas within 200 feet of shellfish waters that are open to public harvesting	Source areas for nutrient-sensitive surface waters that are susceptible to eutrophication or to loss of shellfish or finfish nursery areas due to nutrient inputs	Source areas within 100 feet of secondary recreational waters that are used for swimming on an unorganized basis	Poor, unproductive glacial till aquifers or productive aquifers isolated from the surface or not used for many private wells
Vulnerability Rating	High	R5	R4	R3	R3	R3	R2b	R2a	R1
	Mod.	R5	R4	R3	R3	R3	R2b	R1	R1
	Low	R5	R3	R3	R2a	R2a	R2b	R1	R1

Highest Value Resource → Lowest Value Resource

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Table 7 EPA Table 3-28 Treatment Performance Standards in Various Control Zones

Table 3-28. Treatment performance standards in various control zones

Vertical separation distance (feet)	Control zone (with management entity)					
	R1	R2a	R2b	R3	R4	R5
	Treatment performance standard					
>4	TS1	TS1	TS1 OR TS4	TS1	TS2	TS4
3 to 4	TS1	TS1	TS1 OR TS4	TS2	TS2	TS5
2 to 3	TS1	TS2	TS2 OR TS4	TS3	TS3	NA
1 to 3	TS2	TS3	TS3 OR TS4	TS4	TS4	NA
<1	TS3	TS4	TS4	TS5	TS5	NA

Increasing Resource Value →

Increasing Vulnerability ↑

Table 8 EPA Table 3-27 proposed Onsite Treatment System Performance Standards in Various Control Zones

Table 3-27. Proposed onsite system treatment performance standards in various control zones

Standard	BOD (mg/L)	TSS (mg/L)	PO_4-P (mg/L)	NH_4-N (mg/L)	NO_3-N (mg/L)	Total N (% removed)[a]	Fecal coliforms (CFU/1000 mL)
TS1 - primary treatment							
TS1u – unfiltered	300	300	15	80	NA	NA	10,000,000
TS1f – filtered	200	80	15	80	NA	NA	10,000,000
TS2 - secondary treatment	30	30	15	10	NA	NA	50,000
TS3 - tertiary treatment	10	10	15	10	NA	NA	10,000
TS4 - nutrient reduction							
TS4n - nitrogen reduction	10	10	15	5	NA	50%	10,000
TS4p - phosphorus reduction	10	10	2	10	NA	25%	10,000
TS4np - N & P reduction	10	10	2	5	NA	50%	10,000
TS5 - bodily contact disinfection	10	10	15	10	NA	25%	200
TS6 - wastewater reuse	5	5	15	5	NA	50%	14
TS7 - near drinking water	5	5	1	5	10	75%	<1[b]

NA = not available.
[a] Minimum percentage reduction of total nitrogen (as nitrate-nitrogen plus ammonium nitrogen) concentration in the raw, untreated wastewater.
[b] Total coliform colony densities < 50 per 100 mL of effluent.

1.04. Reliability and Acceptance by Local Agencies

A. The City of Malibu approves treatment systems based on many factors including reliability, performance, and proper operation during different use scenarios (long lags between flow events when property is unoccupied during vacations, temporary residence flows, and high peaks for special events).

1.05. Site Constraints

A. Of the units accepted by Malibu only the MicroSepTec ES unit can be easily installed under driveways and other fire access areas. This is critical because in some cases the unit can be installed landward of the structures, under driveways, clear of the limited area seaward of the structures.

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SECTION 7- DESIGN SCENARIO

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PART 1- CURRENT SYSTEM LOCATION TO REMAIN AS-IS NOT TO CURRENT CODE

1.01. Current Lot Descriptions

The following steps were taken to determine system layout for each property:

A. Compilation of Project Information

1. Project Survey

a. An aerial survey of the project was performed by Robert J. Long and Associates (date of photography February 23, 2011)
b. Moffatt & Nichol provided a base file showing all primary structures and the current revetment location
c. Moffatt & Nichol also provided Onsite Wastewater Files showing current system locations based on three sources:

1). County Files
2). City Files
3). Actual Site Observation and Inventory of Property

1.02. System placement (see Section 7-Part 4-, page 52 for design examples)

A. Items in Section 7-1.01 were used to determine placement of existing septic systems and dispersal fields (see Figure 7, page 43 for partial and Appendix A for complete layout).

1.03. Existing Septic System String-Line

A. A string-line was drawn from the most seaward edge of existing dispersal field

B. The string-line was drawn in a manner that most closely represented the extents that would be used to determine the alignment of a shoreline protective device (seawall or revetment), i.e. a relatively smooth alignment along the seaward envelope of OSTS locations, vs. a more "jagged" string-line defined by each OSTS location (see Figure 7, page 43 for partial and Appendix A for complete layout).

1.04. OSTS setback to protection device

A. Setback to OSTS protection device was determined by offsetting the OSTS string-line 6' seaward (see Figure 7, page 43 for partial and Appendix A for complete layout).

1.05. OSTS setback to wave up-rush line

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A. Setback to wave up-rush line was determined by offsetting the OSTS string-line 15' seaward (<u>see</u> Figure 7, page 43 for partial and Appendix A for complete layout).

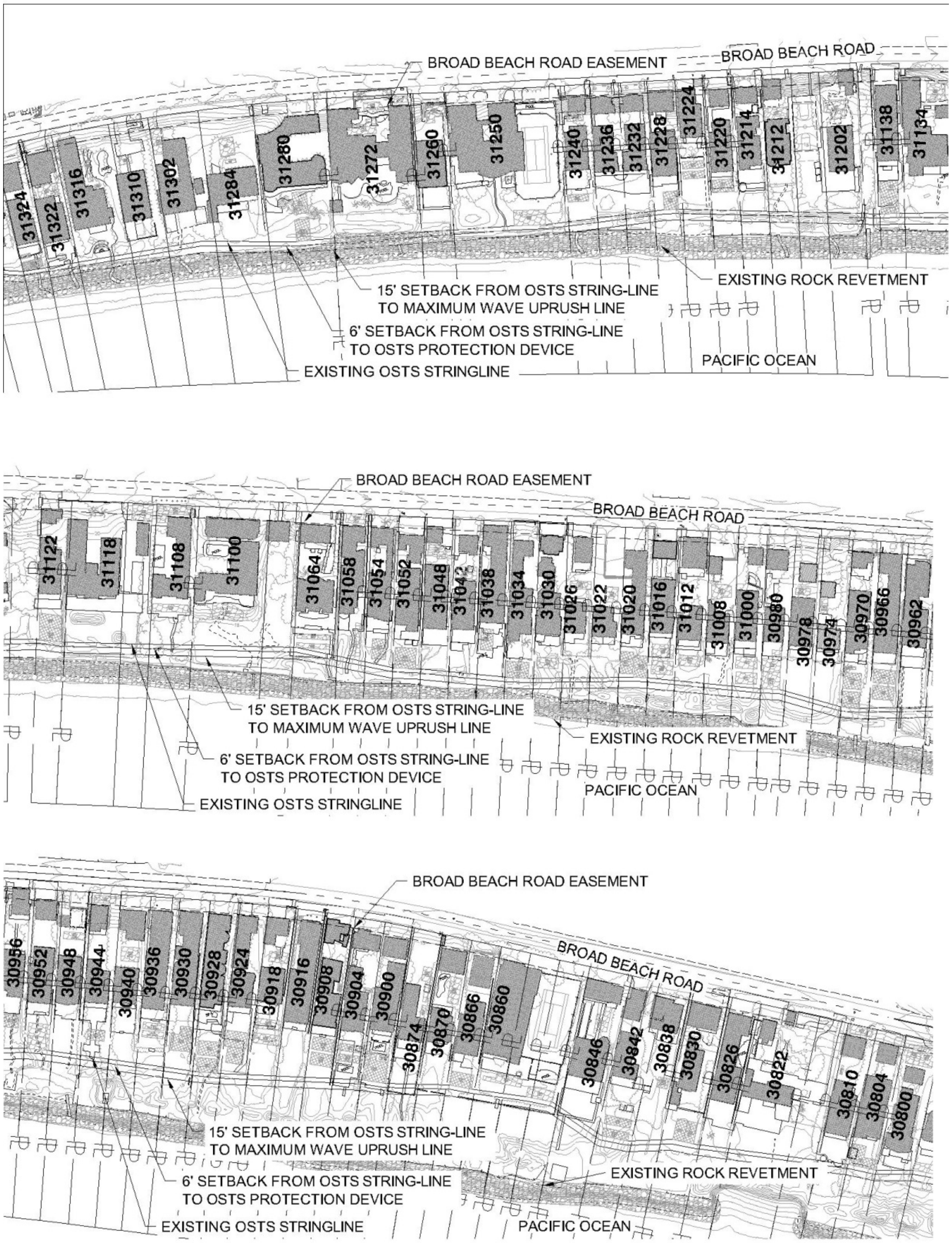

Figure 7 Lot Configuration Existing OSTS

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PART 2- INDIVIDUAL LOT OSTS DESIGN TO MEET CURRENT CODE

2.01. Design Methodology and Lot Descriptions (see Section 7-Part 4-, page 52 for design examples)

The following steps were taken to determine system layout for each property:

A. Compilation of Project Information

1. Project Survey

a. An aerial survey of the project was performed by Robert J. Long and Associates (date of photography February 23, 2011)
b. Moffatt & Nichol provided a base file showing all primary structures and the current revetment location
c. Moffatt & Nichol also provided Onsite Wastewater Files showing current system locations based on an inventory of systems along Broad Beach performed by Topanga Underground (TU) which compiled information from three sources:

1). County Files
2). City Files
3). Actual Site Observation and Inventory of Property

B. Structure type

For this project primary structures were assumed to be habitable structures and parking structures.

Decks, pools, tea-rooms, spas, gazebos, and other non-habitable structures were not considered primary structures

C. Bedroom count

Data from Section 7-2.01.A.1.c was used to determine number of bedrooms (total for property)

D. Soil type

Based on the location of the properties all properties were designed assuming coarse, single grained sand.

2.02. System placement (see Section 7-Part 4-, page 52 for design examples)

A. Items in Section 7-2.01 were used to determine placement of treatment system and dispersal field based on calculations performed in accordance with Section 7-3.01.

2.03. OSTS String-Line

A. Once all OSTS systems were placed on properties a string-line was drawn from the most seaward edge of each field

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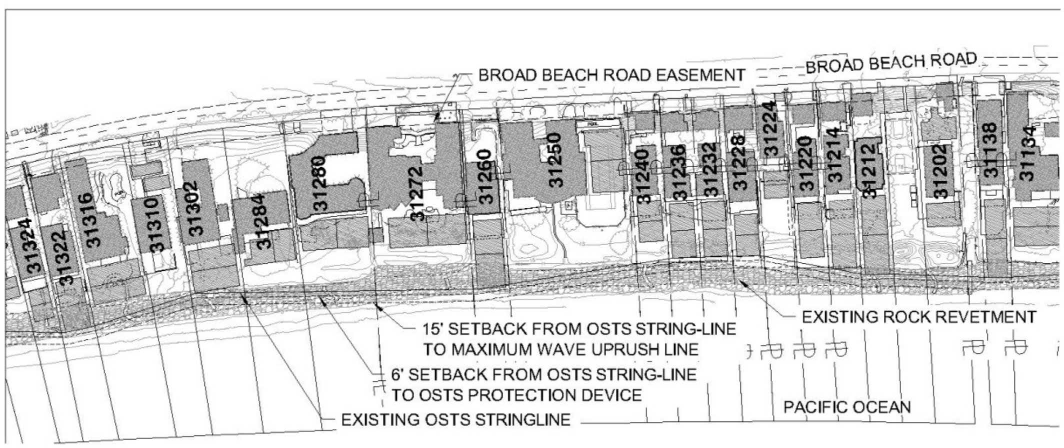
B. The string-line was drawn in a manner that most closely represented the extents that would be used to determine the alignment of a shoreline protective device (seawall or revetment), i.e. a relatively smooth alignment along the seaward envelope of OSTS locations, vs. a more "jagged" string-line defined by each OSTS location

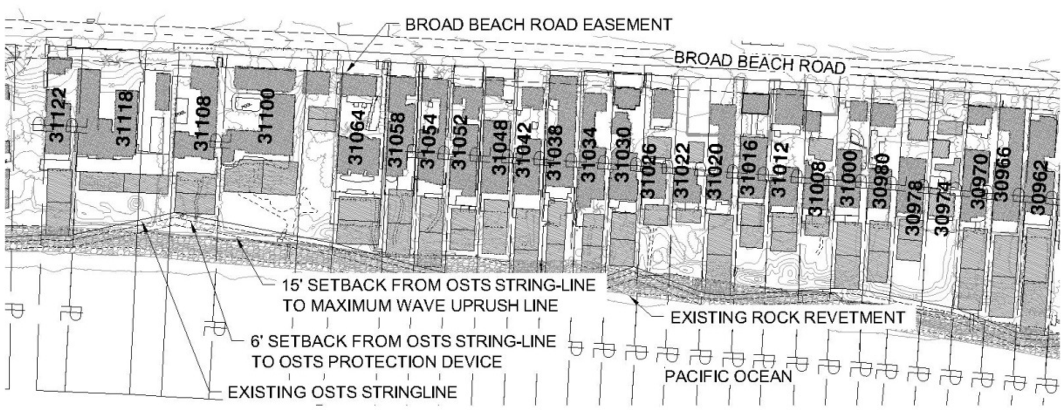
2.04. OSTS setback to protection device

A. Setback to OSTS protection device was determined by offsetting the OSTS string-line 6' seaward

2.05. OSTS setback to wave up-rush line

A. Setback to wave up-rush line was determined by offsetting the OSTS string-line 15' seaward.





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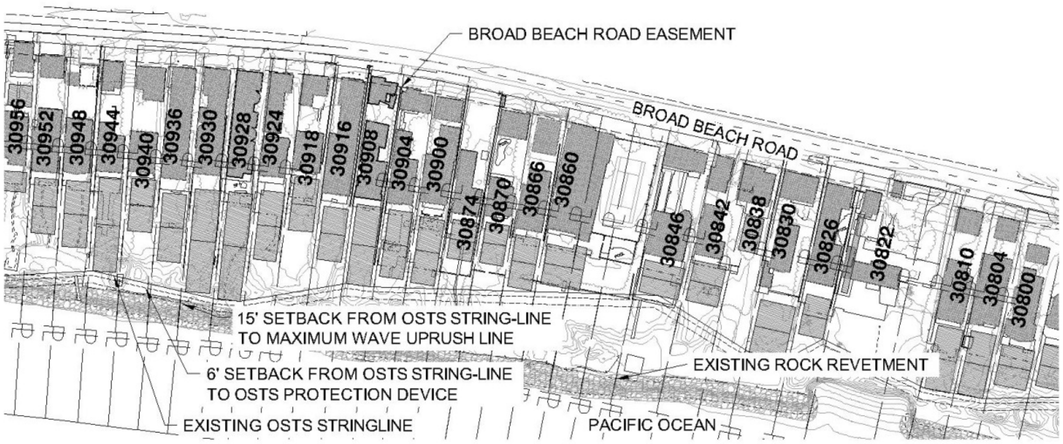

Figure 8 Lot Configuration OSTS Design to Meet Current Code

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PART 3- CALCULATIONS

3.01. Methodology

A. Assumptions (see Table 5, page 26)

B. Equations:

1. OSTS Dispersal Area

$$A_T = A_A + A_F$$
$$A_A = \frac{Q_T}{D_A}$$
$$Q_T = Q_B \times n_B$$
$$A_F = A_A$$

where:

A_T = OSTS total dispersal field area, ft^2

A_A = OSTS active dispersal field area, ft^2

A_F = OSTS future dispersal field area, ft^2

Q_T = OSTS design flow, $\frac{gal}{day}$, gpd

D_A = OSTS dispersal field application rate, $\frac{gal}{day \cdot ft^2}$, gpd/ft^2

Q_B = OSTS design flow per bedroom, $\frac{gal}{day \cdot bdrm}$, $gpd/bdrm$

n_B = total number of bedrooms on property, $bdrm$

(eq. 1)

2. OSTS Treatment Unit Selection

$$T_M = \begin{cases} \text{ES6} & \text{if } Q_T \le 600gpd \\ \text{ES12} & \text{if } 600gpd < Q_T \le 1200gpd \\ \text{ES25} & \text{if } 1200gpd < Q_T \le 2500gpd \end{cases}$$

(eq. 2)

where:

Q_T = OSTS design flow, gal/day, gpd

T_M = treatment unit model

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3.02. Design Results

Table 9 OSTS System Design Table 001

	OSTS DESIGN SUMMARY TABLE								
Address	System Inventory Source	Number of Bedrooms	Wastewater Generation Per Bedroom (gpd/bdrm) (LCP 18.7.N)	Wastewater Flow in Gallons per Day (gpd)	OSTS Treatment Required	OSTS Dispersal Application Rate (gpd/sf) (LCP 18.7.O)	Active Leachfield Area Required in Square Feet (sf) (LCP 18.7.O)	Future Expansion Leachfield Area Required in Square Feet (sf) (LCP 18 7 O)	Total Leachfield Area Required in Square Feet (sf) (LCP 18.7.O)
		n_B	Q_B	$Q_T = Q_B(n_B)$		D_A	$A_A = Q_T/D_A$	$A_F = A_A$	$A_T = A_A + A_F$
			300				**1.2**		
31346	County	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31340	County	2	300	600	ES6	1 2	500	500	1,000
31336	City	3	300	900	ES12	1 2	750	750	1,500
31330	County	2	300	600	ES6	1 2	500	500	1,000
31324	County	2	300	600	ES6	1 2	500	500	1,000
31322	TU	4	300	1,200	ES12	1 2	1,000	1,000	2,000
31316	City	6	300	1,800	ES25	1 2	1,500	1,500	3,000
31310	City	2	300	600	ES6	1 2	500	500	1,000
31302	County	6	300	1,800	ES25	1 2	1,500	1,500	3,000
31284	County	4	300	1,200	ES12	1 2	1,000	1,000	2,000
31280	County	6	300	1,800	ES25	1 2	1,500	1,500	3,000
31272	TU	7	300	2,100	ES25	1 2	1,750	1,750	3,500
31260	City	6	300	1,800	ES25	1 2	1,500	1,500	3,000
31250	TU	7	300	2,100	ES25	1 2	1,750	1,750	3,500
31240	County	3	300	900	ES12	1 2	750	750	1,500
31236	City	4	300	1,200	ES12	1 2	1,000	1,000	2,000
31232	City	4	300	1,200	ES12	1 2	1,000	1,000	2,000
31228	County	3	300	900	ES12	1 2	750	750	1,500
31224	County	2	300	600	ES6	1 2	500	500	1,000
31220	County	4	300	1,200	ES12	1 2	1,000	1,000	2,000
31214	County	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31212	City	6	300	1,800	ES25	1 2	1,500	1,500	3,000
31202	County	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31138	County	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31134	City	6	300	1,800	ES25	1 2	1,500	1,500	3,000
31122	County	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31118	City	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31108	County	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31100	City	7	300	2,100	ES25	1 2	1,750	1,750	3,500
31070	City	2	300	600	ES6	1 2	500	500	1,000
31064	City	6	300	1,800	ES25	1 2	1,500	1,500	3,000
31058	County	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31054	City	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31052	County	3	300	900	ES12	1 2	750	750	1,500
31048	City	4	300	1,200	ES12	1 2	1,000	1,000	2,000
31042	City	6	300	1,800	ES25	1 2	1,500	1,500	3,000
31038	City	5	300	1,500	ES25	1 2	1,250	1,250	2,500
31034	County	4	300	1,200	ES12	1 2	1,000	1,000	2,000
31030	County	4	300	1,200	ES12	1 2	1,000	1,000	2,000
31026	City	3	300	900	ES12	1 2	750	750	1,500
31022	City	2	300	600	ES6	1 2	500	500	1,000
31020	County	6	300	1,800	ES25	1 2	1,500	1,500	3,000
31016	County	3	300	900	ES12	1 2	750	750	1,500
31012	City	3	300	900	ES12	1 2	750	750	1,500
31008	City	3	300	900	ES12	1 2	750	750	1,500
31000	City	5	300	1,500	ES25	1 2	1,250	1,250	2,500
30980	TU	4	300	1,200	ES12	1 2	1,000	1,000	2,000
30978	County	3	300	900	ES12	1 2	750	750	1,500
30974	TU	2	300	600	ES6	1 2	500	500	1,000

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Table 10 OSTS System Design Table 002

OSTS DESIGN SUMMARY TABLE

Address	System Inventory Source	Number of Bedrooms	Wastewater Generation Per Bedroom (gpd/bdrm) (LCP 18.7.N)	Wastewater Flow in Gallons per Day (gpd)	OSTS Treatment Required	OSTS Dispersal Application Rate (gpd/sf) (LCP 18.7.O)	Active Leachfield Area Required in Square Feet (sf) (LCP 18.7.O)	Future Expansion Leachfield Area Required in Square Feet (sf) (LCP 18.7.O)	Total Leachfield Area Required in Square Feet (sf) (LCP 18.7.O)
		n_B	Q_B	$Q_T = Q_B(n_B)$		D_A	$A_A = Q_T/D_A$	$A_F = A_A$	$A_T = A_A + A_F$
			300			**1.2**			
30970	City	6	300	1,800	ES25	1 2	1,500	1,500	3,000
30966	County	6	300	1,800	ES25	1 2	1,500	1,500	3,000
30962	City	8	300	2,400	ES25	1 2	2,000	2,000	4,000
30956	TU	3	300	900	ES12	1 2	750	750	1,500
30952	County	4	300	1,200	ES12	1 2	1,000	1,000	2,000
30948	TU	5	300	1,500	ES25	1 2	1,250	1,250	2,500
30944	City	7	300	2,100	ES25	1 2	1,750	1,750	3,500
30940	City	4	300	1,200	ES12	1 2	1,000	1,000	2,000
30936	TU	5	300	1,500	ES25	1 2	1,250	1,250	2,500
30930	City	8	300	2,400	ES25	1 2	2,000	2,000	4,000
30928	County	8	300	2,400	ES25	1 2	2,000	2,000	4,000
30924	City	5	300	1,500	ES25	1 2	1,250	1,250	2,500
30918	County	4	300	1,200	ES12	1 2	1,000	1,000	2,000
30916	City	4	300	1,200	ES12	1 2	1,000	1,000	2,000
30908	City	6	300	1,800	ES25	1 2	1,500	1,500	3,000
30904	TU	5	300	1,500	ES25	1 2	1,250	1,250	2,500
30900	City	5	300	1,500	ES25	1 2	1,250	1,250	2,500
30874	City	3	300	900	ES12	1 2	750	750	1,500
30870	County	3	300	900	ES12	1 2	750	750	1,500
30866	City	4	300	1,200	ES12	1 2	1,000	1,000	2,000
30860	City	5	300	1,500	ES25	1 2	1,250	1,250	2,500
30846	City	4	300	1,200	ES12	1 2	1,000	1,000	2,000
30842	County	4	300	1,200	ES12	1 2	1,000	1,000	2,000
30838	TU	2	300	600	ES6	1 2	500	500	1,000
30830	TU	6	300	1,800	ES25	1 2	1,500	1,500	3,000
30826	TU	3	300	900	ES12	1 2	750	750	1,500
30822	Ensitu	6	300	1,800	ES25	1 2	1,500	1,500	3,000
30810	City	5	300	1,500	ES25	1 2	1,250	1,250	2,500
30804	City	5	300	1,500	ES25	1 2	1,250	1,250	2,500
30800	County	4	300	1,200	ES12	1 2	1,000	1,000	2,000
30760	City	7	300	2,100	ES25	1 2	1,750	1,750	3,500

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PART 4- OSTS DESIGN EXAMPLES

4.01. Design Examples Base

A. Three projects were selected as "typical" examples (see Figure 9, page 52, and Section 7-4.02, page 53)

1. 31310 Broad Beach
2. 31316 Broad Beach
3. 31322 Broad Beach

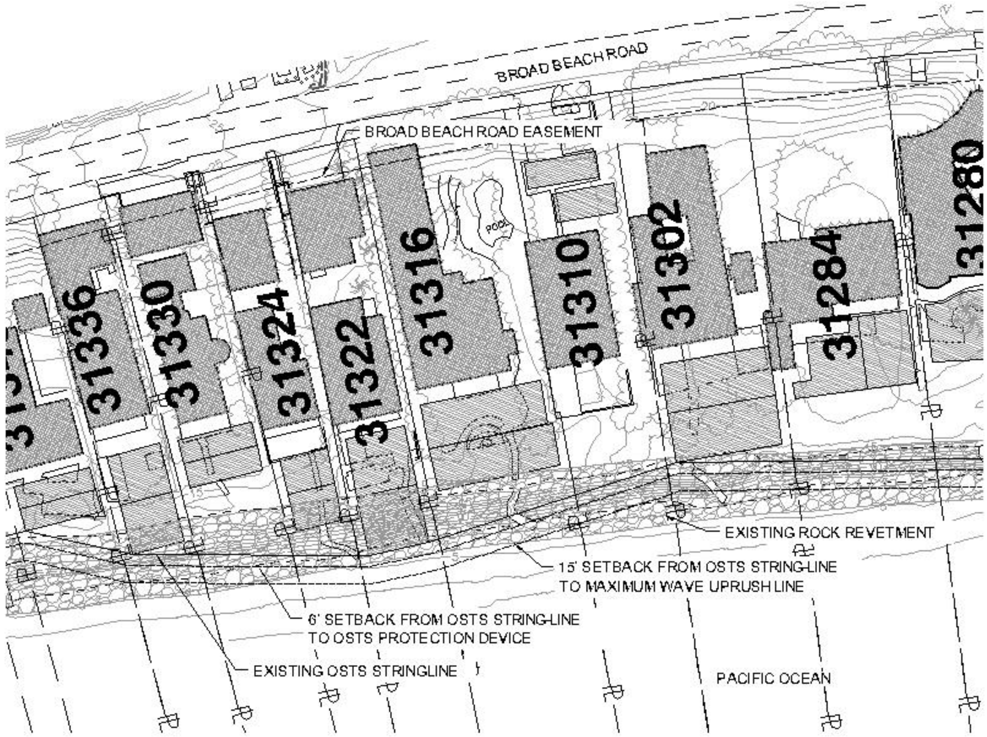

Figure 9 Design Example Figure

B. 31310 Broad Beach

1. Example of property where treatment tank can be placed landward of the residence and the exiting revetment.
2. Active dispersal field can be placed landward of the residence
3. Future dispersal field can be placed landward of the residence

C. 31316 Broad Beach

1. Example of property where treatment tank can be placed landward of the existing revetment.

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2. Active dispersal field can be placed landward of the existing revetment.
3. Future dispersal field cannot be placed landward of the existing revetment

D. 31322 Broad Beach

1. Example of property where treatment tank can be placed landward of the existing revetment.
2. Active dispersal field cannot be placed fully landward of the existing revetment.
3. Future dispersal field cannot be placed landward of the existing revetment

4.02. Design Example Individual Property OSTS

A. 31310 Broad Beach Road

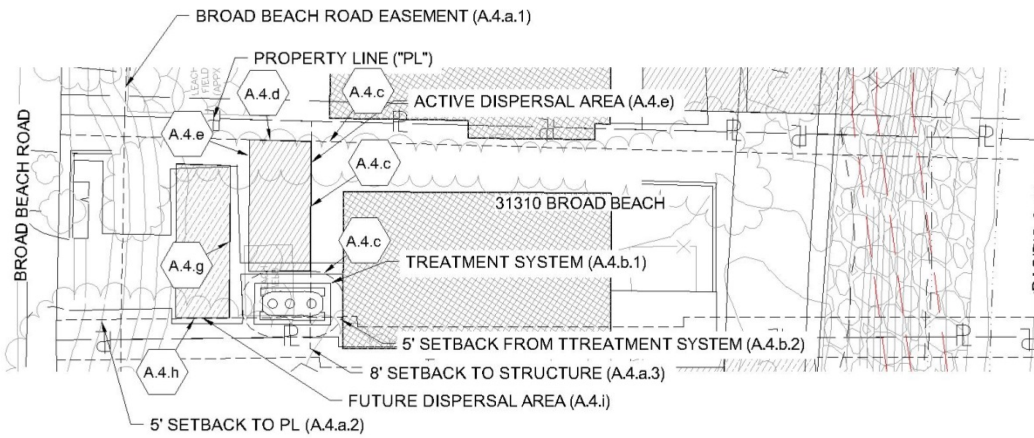

Figure 10 Design Example 31310 Broad Beach

1. Research
   a. EEI determined that the City had an approval on record from August 8, 2007
   b. Approval provided number of bedrooms and number of fixtures
2. Data Acquired from Research
   a. Number of Bedrooms n_B=2 bdrm
   b. Design Flow Per Bedroom Q_B=300 gpd/bdrm
   c. Dispersal Field Application Rate D_A=1.2 gpd/sf
3. Calculations

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$$Q_B = 300\, {}^{gpd}\!/_{bdrm}$$
$$n_B = 2\, bdrm$$
$$D_A = 1.2\, {}^{gpd}\!/_{ft^2} \quad \text{(eq. 3)}$$
$$Q_T = Q_B \times n_B = 300\, {}^{gpd}\!/_{bdrm} \times 2\, bdrm = 600\, gpd$$
$$A_A = \frac{Q_T}{D_A} = \frac{600\, gpd}{1.2\, {}^{gpd}\!/_{ft^2}} = 500\, ft^2$$
$$A_F = A_A = 500\, ft^2$$
$$A_T = A_A + A_F = 500\, ft^2 + 500\, ft^2 = 1000\, ft^2$$

$$Q_T = 600\, gpd \quad \text{(eq. 4)}$$
$$T_M = \{ ES6 \quad Q_T \le 600\, gpd$$

4. System layout (see Figure 10, page 53)
   a. Draw all critical setbacks
      1). Broad Beach Road Easement
      2). 5' setback to Property Line
      3). 8' Setback to Structure
   b. Place Treatment System and Setback
      1). Place treatment system in drawing
      2). Draw 5' setback to treatment system and check clearance to structure
   c. Determine width of Active Dispersal System based on 8' setback to structure, 5' setback to Property Line, and 5' setback to Treatment System
   d. Determine minimum length of field (assuming rectangle)
      1). $l_A = \frac{A_A}{w_A}$ (eq. 5)
   e. Draw Active Dispersal System closed poly line and check area (area 500.3 sf)
   f. Draw 5' setback to Active Dispersal System
   g. Determine width of Future Dispersal System based on 5' setback to Property Line
   h. Determine minimum length of field (assuming Rectangle)
      1). $l_F = \frac{A_F}{w_F}$ (eq. 6)
   i. Draw Future Dispersal System closed poly line and check area (area 509.8 sf)

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B. 31316 Broad Beach Road

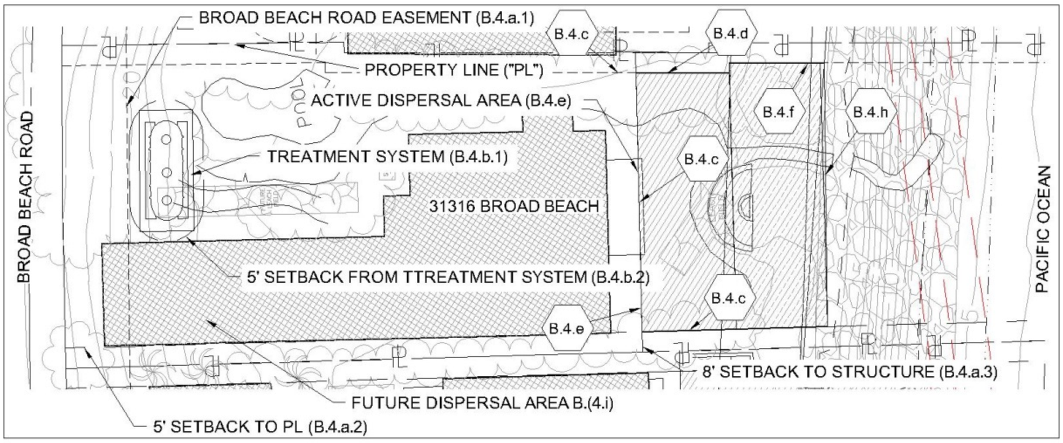

Figure 11 Design Example 31316 Broad Beach

1. Research
   a. EEI determined that the City had an approval on record from September 16, 1994
   b. Approval provided number of bedrooms and number of fixtures
2. Data Acquired from Research
   a. Number of Bedrooms n_B=6 bdrm
   b. Design Flow Per Bedroom Q_B=300 gpd/bdrm
   c. Dispersal Field Application Rate D_A=1.2 gpd/sf
3. Calculations

$$Q_B = 300 \, {}^{gpd}\!/_{bdrm}$$
$$n_B = 6 \, bdrm$$
$$D_A = 1.2 \, {}^{gpd}\!/_{ft^2} \qquad \text{(eq. 7)}$$
$$Q_T = Q_B \times n_B \quad = 300 \, {}^{gpd}\!/_{bdrm} \times 6 \, bdrm \quad = 1{,}800 \, gpd$$
$$A_A = \frac{Q_T}{D_A} \quad = \frac{1{,}800 \, gpd}{1.2 \, {}^{gpd}\!/_{ft^2}} \quad = 1{,}500 \, ft^2$$
$$A_F = A_A \quad = 1{,}500 \, ft^2$$
$$A_T = A_A + A_F \quad = 1{,}500 \, ft^2 + 1{,}500 \, ft^2 \quad = 3{,}000 \, ft^2$$

$$Q_T = 1{,}800 \, gpd \qquad \text{(eq. 8)}$$
$$T_M = \{ \text{ES25} \quad 1200 \, gpd < Q_T \leq 2500 \, gpd$$

4. System layout (see Figure 11, page 55)
   a. Draw all critical setbacks
      1). Broad Beach Road Easement
      2). 5’ setback to Property Line

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3). 8' Setback to Structure

b. Place Treatment System and Setback

1). Place treatment system in drawing
2). Draw 5' setback to treatment system and check clearance to structure

c. Determine width of Active Dispersal System based on 8' setback to structure and 5' setback to Property Lines
d. Determine minimum length of field (assuming rectangle)

1). $l_A = \frac{A_A}{w_A}$ (eq. 9)

e. Draw Active Dispersal System closed poly line and check area (area 1,500 sf)
f. Determine width of Future Dispersal System based on 5' setback to Property Lines
g. Determine minimum length of field (assuming Rectangle)

1). $l_F = \frac{A_F}{w_F}$ (eq. 10)

h. Draw Future Dispersal System closed poly line and check area (area 1500 sf)

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C. 31322 Broad Beach Road

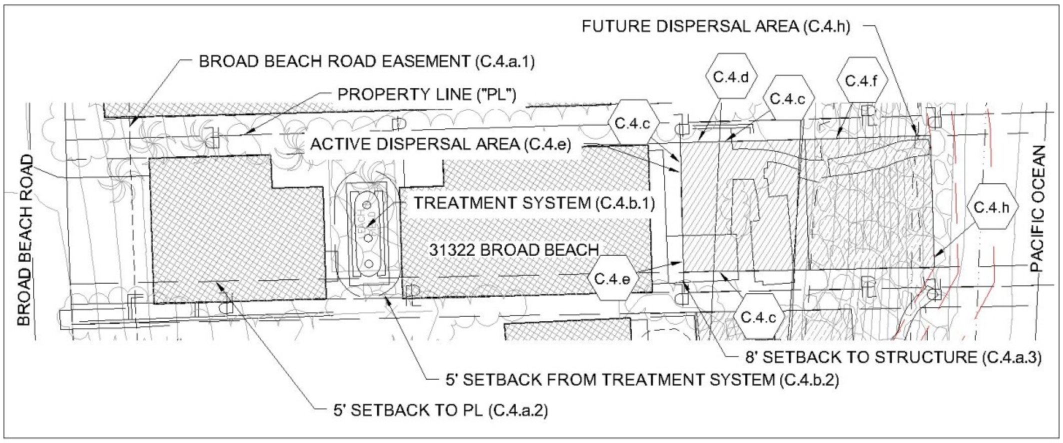

Figure 12 Design Example 31322 Broad Beach

1. Research
   a. EEI determined that there were no submittals or records on file for this project so the site was inventoried
   b. Inventory provided number of bedrooms
2. Data Acquired from Research
   a. Number of Bedrooms n_B=4 bdrm
   b. Design Flow Per Bedroom Q_B=300 gpd/bdrm
   c. Dispersal Field Application Rate D_A=1.2 gpd/sf
3. Calculations

$$Q_B = 300\, {}^{gpd}\!/_{bdrm}$$
$$n_B = 4\, bdrm$$
$$D_A = 1.2\, {}^{gpd}\!/_{ft^2} \qquad \text{(eq. 11)}$$
$$Q_T = Q_B \times n_B \quad = 300\, {}^{gpd}\!/_{bdrm} \times 4\, bdrm \quad = 1,200\, gpd$$
$$A_A = \frac{Q_T}{D_A} \quad = \frac{1,200\, gpd}{1.2\, {}^{gpd}\!/_{ft^2}} \quad = 1,000\, ft^2$$
$$A_F = A_A \quad = 1,000\, ft^2$$
$$A_T = A_A + A_F \quad = 1,000\, ft^2 + 1,000\, ft^2 \quad = 2,000\, ft^2$$

$$Q_T = 1,200\, gpd \qquad \text{(eq. 12)}$$
$$T_M = \{ \text{ES12} \quad \text{if } 600 gpd < Q_T \le 1200 gpd$$

4. System layout (see Figure 12, page 57)
   a. Draw all critical setbacks
      1). Broad Beach Road Easement
      2). 5’ setback to Property Line

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3). 8' Setback to Structure

b. Place Treatment System and Setback

1). Place treatment system in drawing
2). Draw 5' setback to treatment system and check clearance to structure

c. Determine width of Active Dispersal System based on 8' setback to structure and 5' setback to Property Lines
d. Determine minimum length of field (assuming rectangle)

1). $l_A = \frac{A_A}{w_A}$ (eq. 13)

e. Draw Active Dispersal System closed poly line and check area (area 1,000 sf)
f. Determine width of Future Dispersal System based on 5' setback to Property Lines
g. Determine minimum length of field (assuming Rectangle)

1). $l_F = \frac{A_F}{w_F}$ (eq. 14)

h. Draw Future Dispersal System closed poly line and check area (area 1000 sf)

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SECTION 8- SYSTEM COSTS

PART 1- METHODOLOGY AND CALCULATIONS

1.01. Total System Cost

A. Total System Cost is defined as follows:

$$
\begin{aligned}
C_{total} &= C_E + C_D + C_S \\
C_E &= \text{cost of equipment+ installation costs} \\
&= C_e + C_i \\
C_i &= 1.5(C_e) \\
C_D &= \text{cost of dispersal field equipment and installation} \\
&= 17 \ {}^{\$}\!/\!_{ft^2}(A_A) \\
C_S &= \text{cost of site work for OSTS installation} \\
&= C_l + C_h + C_{sr} + C_{lr} \\
C_l &= \text{cost of removal of landsaping} \\
&= 0, \text{ included in base dispersal field cost } C_D \\
C_h &= \text{cost of removal of hardscape} \\
&= 15 \ {}^{\$}\!/\!_{ft^2}(A_h) \\
A_h &= \text{area of hardscape to be removed, } ft^2 \\
C_{sr} &= \text{cost of removal of structures} \\
&= 40 \ {}^{\$}\!/\!_{ft^2}(A_{sr}) \\
A_{sr} &= \text{area of structures to be removed, } ft^2 \\
C_{lr} &= \text{cost of replacement of landcape and hardscape} \\
&= 100 \ {}^{\$}\!/\!_{ft^2}(A_{lr}) \\
A_{lr} &= \text{area of landscape and hardscape to be replaced, } ft^2
\end{aligned}
\qquad \text{(eq. 15)}
$$

1. Equipment Cost:
   a. ES-6 $17,000
   b. ES-12 $22,000
   c. ES-25 $35,000
2. Equipment installation cost: assume cost of equipment x 1.5
3. Dispersal field installation cost: assume $17 per square foot
4. Cost of site work
   a. Item includes removal of all non-primary structure in location of system
   b. Landscape removal only is included in base dispersal field installation cost
   c. Hardscape removal (decks, paths, walkways, etc.) Assume additional $15 per square foot

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d. Structure removal (pools, gazebos, covered structures, etc.)
   Assume $40 per square foot.
e. Replacement of landscaping and hardscaping after installation
   Assume $100 per square foot

1.02. Cost Results (<u>see</u> Table 12, page 62, and examples Section 8-2.01, page 63)

A. Total OSTS Cost (excluding installation of future) $17,011,145

B. Average OSTS Cost (excluding installation of future) $212,639

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OSTS SYSTEM COSTS SUMMARY TABLE												
Address	Equipment Costs			Dispersal Costs	Existing Landscape, Hardscape, and Structure Reomval Costs							Total Cost
	C_e	C_i	$C_E = C_e + C_i$	C_D	A_h	C_h	A_{sr}	C_{sr}	A_L	C_{lr}	$C_S = C_h + C_{sr} + C_{lr}$	$C_T = C_E + C_D + C_S$
31346	$35,000	$52,500	$87,500	$21,250	0	$0	1,250	$50,000	1,250	$125,000	$175,000	$283,750
31340	$17,000	$25,500	$42,500	$8,500	115	$1,725	0	$0	500	$50,000	$51,725	$102,725
31336	$22,000	$33,000	$55,000	$12,750	750	$11,250	0	$0	750	$75,000	$86,250	$154,000
31330	$17,000	$25,500	$42,500	$8,500	0	$0	0	$0	500	$50,000	$50,000	$101,000
31324	$17,000	$25,500	$42,500	$8,500	153	$2,295	0	$0	500	$50,000	$52,295	$103,295
31322	$22,000	$33,000	$55,000	$17,000	538	$8,070	462	$18,480	1,000	$100,000	$126,550	$198,550
31316	$35,000	$52,500	$87,500	$25,500	1,100	$16,500		$0	1,500	$150,000	$166,500	$279,500
31310	$17,000	$25,500	$42,500	$8,500	35	$525	0	$0	500	$50,000	$50,525	$101,525
31302	$35,000	$52,500	$87,500	$25,500	902	$13,530	0	$0	1,500	$150,000	$163,530	$276,530
31284	$22,000	$33,000	$55,000	$17,000		$0		$0	1,000	$100,000	$100,000	$172,000
31280	$35,000	$52,500	$87,500	$25,500	690	$10,350		$0	1,500	$150,000	$160,350	$273,350
31272	$35,000	$52,500	$87,500	$29,750	0	$0	928	$37,120	1,750	$175,000	$212,120	$329,370
31260	$35,000	$52,500	$87,500	$25,500	771	$11,565	0	$0	1,500	$150,000	$161,565	$274,565
31250	$35,000	$52,500	$87,500	$29,750	0	$0	0	$0	1,750	$175,000	$175,000	$292,250
31240	$22,000	$33,000	$55,000	$12,750	750	$11,250	0	$0	750	$75,000	$86,250	$154,000
31236	$22,000	$33,000	$55,000	$17,000	522	$7,830	0	$0	1,000	$100,000	$107,830	$179,830
31232	$22,000	$33,000	$55,000	$17,000	686	$10,290	0	$0	1,000	$100,000	$110,290	$182,290
31228	$22,000	$33,000	$55,000	$12,750	0	$0	0	$0	750	$75,000	$75,000	$142,750
31224	$17,000	$25,500	$42,500	$8,500	0	$0	0	$0	500	$50,000	$50,000	$101,000
31220	$22,000	$33,000	$55,000	$17,000	560	$8,400		$0	1,000	$100,000	$108,400	$180,400
31214	$35,000	$52,500	$87,500	$21,250	661	$9,915		$0	1,250	$125,000	$134,915	$243,665
31212	$35,000	$52,500	$87,500	$25,500	606	$9,090		$0	1,500	$150,000	$159,090	$272,090
31202	$35,000	$52,500	$87,500	$21,250	0	$0	0	$0	1,250	$125,000	$125,000	$233,750
31138	$35,000	$52,500	$87,500	$21,250	1,250	$18,750	0	$0	1,250	$125,000	$143,750	$252,500
31134	$35,000	$52,500	$87,500	$25,500	0	$0	0	$0	1,500	$150,000	$150,000	$263,000
31122	$35,000	$52,500	$87,500	$21,250	0	$0	0	$0	1,250	$125,000	$125,000	$233,750
31118	$35,000	$52,500	$87,500	$21,250	0	$0	0	$0	1,250	$125,000	$125,000	$233,750
31108	$35,000	$52,500	$87,500	$21,250	0	$0	0	$0	1,250	$125,000	$125,000	$233,750
31100	$35,000	$52,500	$87,500	$29,750	0	$0	260	$10,400	1,750	$175,000	$185,400	$302,650
31070	$17,000	$25,500	$42,500	$8,500	0	$0	0	$0	500	$50,000	$50,000	$101,000
31064	$35,000	$52,500	$87,500	$25,500	1,500	$22,500	0	$0	1,500	$150,000	$172,500	$285,500
31058	$35,000	$52,500	$87,500	$21,250	205	$3,075	0	$0	1,250	$125,000	$128,075	$236,825
31054	$35,000	$52,500	$87,500	$21,250	416	$6,240	210	$8,400	1,250	$125,000	$139,640	$248,390
31052	$22,000	$33,000	$55,000	$12,750	0	$0	158	$6,320	750	$75,000	$81,320	$149,070
31048	$22,000	$33,000	$55,000	$17,000	503	$7,545	0	$0	1,000	$100,000	$107,545	$179,545
31042	$35,000	$52,500	$87,500	$25,500	390	$5,850	0	$0	1,500	$150,000	$155,850	$268,850
31038	$35,000	$52,500	$87,500	$21,250	220	$3,300	528	$21,120	1,250	$125,000	$149,420	$258,170
31034	$22,000	$33,000	$55,000	$17,000	501	$7,515	0	$0	1,000	$100,000	$107,515	$179,515
31030	$22,000	$33,000	$55,000	$17,000	0	$0	0	$0	1,000	$100,000	$100,000	$172,000
31026	$22,000	$33,000	$55,000	$12,750	750	$11,250	0	$0	750	$75,000	$86,250	$154,000

Table 11 OSTS Cost Table 002

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OSTS SYSTEM COSTS SUMMARY TABLE												
Address	Equipment Costs			Dispersal Costs	Existing Landscape, Hardscape, and Structure Reomval Costs							Total Cost
	C_e	C_i	$C_E = C_e + C_i$	C_D	A_h	C_h	A_{sr}	C_{sr}	A_L	C_{lr}	$C_S = C_h + C_{sr} + C_{lr}$	$C_T = C_E + C_D + C_S$
31022	$17,000	$25,500	$42,500	$8,500	500	$7,500	0	$0	500	$50,000	$57,500	$108,500
31020	$35,000	$52,500	$87,500	$25,500	470	$7,050	0	$0	1,500	$150,000	$157,050	$270,050
31016	$22,000	$33,000	$55,000	$12,750	750	$11,250	0	$0	750	$75,000	$86,250	$154,000
31012	$22,000	$33,000	$55,000	$12,750	750	$11,250	0	$0	750	$75,000	$86,250	$154,000
31008	$22,000	$33,000	$55,000	$12,750	750	$11,250	0	$0	750	$75,000	$86,250	$154,000
31000	$35,000	$52,500	$87,500	$21,250	195	$2,925	0	$0	1,250	$125,000	$127,925	$236,675
30980	$22,000	$33,000	$55,000	$17,000	0	$0	220	$8,800	1,000	$100,000	$108,800	$180,800
30978	$22,000	$33,000	$55,000	$12,750	0	$0	364	$14,560	750	$75,000	$89,560	$157,310
30974	$17,000	$25,500	$42,500	$8,500	500	$7,500	0	$0	500	$50,000	$57,500	$108,500
30970	$35,000	$52,500	$87,500	$25,500	102	$1,530	335	$13,400	1,500	$150,000	$164,930	$277,930
30966	$35,000	$52,500	$87,500	$25,500	0	$0	0	$0	1,500	$150,000	$150,000	$263,000
30962	$35,000	$52,500	$87,500	$34,000	0	$0	0	$0	2,000	$200,000	$200,000	$321,500
30956	$22,000	$33,000	$55,000	$12,750	750	$11,250	0	$0	750	$75,000	$86,250	$154,000
30952	$22,000	$33,000	$55,000	$17,000	733	$10,995	270	$10,800	1,000	$100,000	$121,795	$193,795
30948	$35,000	$52,500	$87,500	$21,250	365	$5,475	0	$0	1,250	$125,000	$130,475	$239,225
30944	$35,000	$52,500	$87,500	$29,750	580	$8,700	0	$0	1,750	$175,000	$183,700	$300,950
30940	$22,000	$33,000	$55,000	$17,000	1,000	$15,000	0	$0	1,000	$100,000	$115,000	$187,000
30936	$35,000	$52,500	$87,500	$21,250	0	$0	0	$0	1,250	$125,000	$125,000	$233,750
30930	$35,000	$52,500	$87,500	$34,000	0	$0	0	$0	2,000	$200,000	$200,000	$321,500
30928	$35,000	$52,500	$87,500	$34,000	180	$2,700	245	$9,800	2,000	$200,000	$212,500	$334,000
30924	$35,000	$52,500	$87,500	$21,250	514	$7,710	0	$0	1,250	$125,000	$132,710	$241,460
30918	$22,000	$33,000	$55,000	$17,000	230	$3,450	480	$19,200	1,000	$100,000	$122,650	$194,650
30916	$22,000	$33,000	$55,000	$17,000	1,000	$15,000	0	$0	1,000	$100,000	$115,000	$187,000
30908	$35,000	$52,500	$87,500	$25,500	253	$3,795	0	$0	1,500	$150,000	$153,795	$266,795
30904	$35,000	$52,500	$87,500	$21,250	545	$8,175	708	$28,320	1,250	$125,000	$161,495	$270,245
30900	$35,000	$52,500	$87,500	$21,250	462	$6,930	0	$0	1,250	$125,000	$131,930	$240,680
30874	$22,000	$33,000	$55,000	$12,750	750	$11,250	0	$0	750	$75,000	$86,250	$154,000
30870	$22,000	$33,000	$55,000	$12,750	324	$4,860	0	$0	750	$75,000	$79,860	$147,610
30866	$22,000	$33,000	$55,000	$17,000	259	$3,885	0	$0	1,000	$100,000	$103,885	$175,885
30860	$35,000	$52,500	$87,500	$21,250	0	$0	0	$0	1,250	$125,000	$125,000	$233,750
30846	$22,000	$33,000	$55,000	$17,000	1,000	$15,000	0	$0	1,000	$100,000	$115,000	$187,000
30842	$22,000	$33,000	$55,000	$17,000	308	$4,620	0	$0	1,000	$100,000	$104,620	$176,620
30838	$17,000	$25,500	$42,500	$8,500	0	$0	0	$0	500	$50,000	$50,000	$101,000
30830	$35,000	$52,500	$87,500	$25,500	0	$0	0	$0	1,500	$150,000	$150,000	$263,000
30826	$22,000	$33,000	$55,000	$12,750	0	$0	0	$0	750	$75,000	$75,000	$142,750
30822	$35,000	$52,500	$87,500	$25,500	0	$0	1,500	$60,000	1,500	$150,000	$210,000	$323,000
30810	$35,000	$52,500	$87,500	$21,250	1,250	$18,750	0	$0	1,250	$125,000	$143,750	$252,500
30804	$35,000	$52,500	$87,500	$21,250	931	$13,965	0	$0	1,250	$125,000	$138,965	$247,715
30800	$22,000	$33,000	$55,000	$17,000	420	$6,300	0	$0	1,000	$100,000	$106,300	$178,300
30760	$35,000	$52,500	$87,500	$29,750	0	$0	0	$0	1,750	$175,000	$175,000	$292,250
											Total	$17,011,145
											Min	$101,000
											Max	$334,000
											Ave	$212,639

Table 12 OSTS Cost Table 001

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PART 2- OSTS COST EXAMPLES

2.01. Cost Examples Base

A. Three projects were selected as "typical" examples (see Figure 13, page 63, and Section 8-2.01.B, page 63)

1. 31310 Broad Beach
2. 31316 Broad Beach
3. 31322 Broad Beach

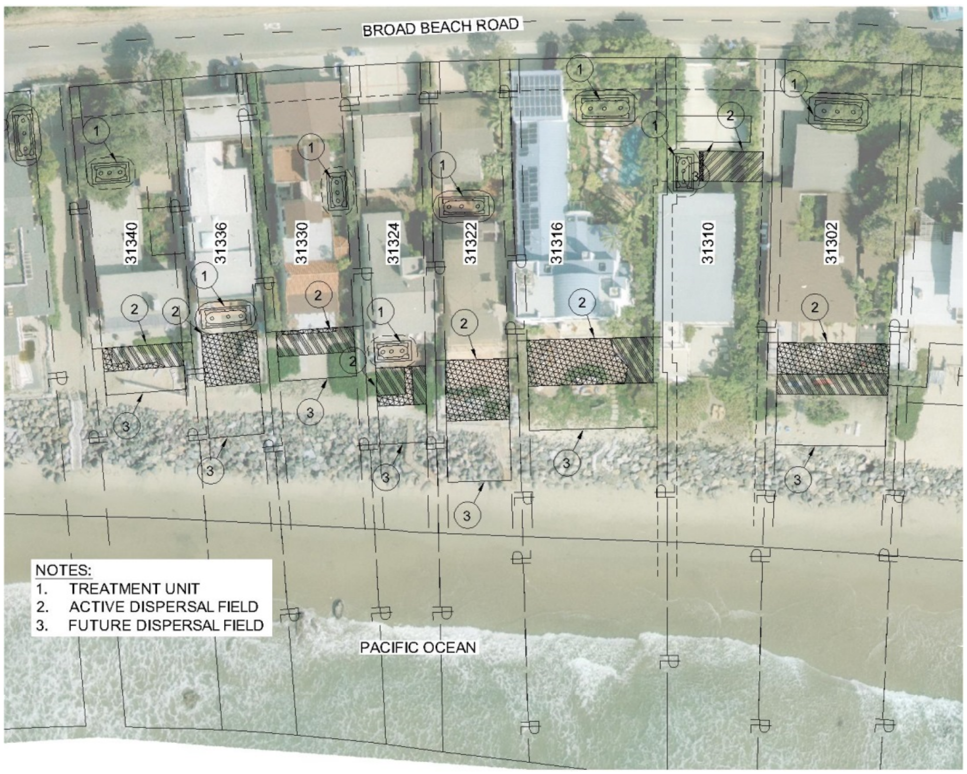

Figure 13 Cost Example Figure

B. 31310 Broad Beach

1. Example of property where treatment tank can be placed landward of the residence and the exiting revetment.
2. Active dispersal field can be placed landward of the residence, primarily in landscape

C. 31316 Broad Beach

1. Example of property where treatment tank can be placed landward of the existing revetment.

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2. Active dispersal field can be placed landward of the existing revetment, primarily in hardscape

D. 31322 Broad Beach

1. Example of property where treatment tank can be placed landward of the existing revetment.

2. Active dispersal field cannot be placed fully landward of the existing revetment under structures and hardscape.

2.02. Cost Example Individual Property OSTS

A. 31310 Broad Beach Road

Figure 14 Cost Example 31310 Broad Beach

1. Research

a. EEI determined from site survey and aerial photography that the dispersal system could be placed primarily under landscaping.

2. Data Acquired from Research and Calculations

a. Number of Bedrooms n_B=2 bdrm
b. Design Flow Per Bedroom Q_B=300 gpd/bdrm
c. Dispersal Field Application Rate D_A=1.2 gpd/sf
d. Treatment System T_M=ES6
e. Dispersal Area Active A_A=A_{lr}=500sf
f. Dispersal Area Future A_F=500sf
g. Area of landscape to be removed A_l=465sf
h. Area of Hardscape to be removed A_h=35sf

3. Calculations

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$$C_e = \$17,000$$
$$C_i = 1.5(17,000) \quad = \$25,000$$
$$C_E = C_e + C_i \quad = \$17,000 + \$25,000$$
$$= \$42,500$$
$$C_D = \text{cost of dispersal field equipment and installation}$$
$$= 17 \ \$/ft^2 (A_A) \quad = 17(500) \quad = \$8,500$$
$$C_S = \text{cost of site work for OSTS installation}$$
$$= C_l + C_h + C_{sr} + C_{lr}$$
$$C_l = 0$$
$$C_h = \text{cost of removal of hardscape}$$
$$= 15 \ \$/ft^2 (A_h) \quad = 15(35) \quad = \$525$$
$$C_{sr} = 0$$
$$C_{lr} = \text{cost of replacement of hardscape and landscape}$$
$$= 100 \ \$/ft^2 (A_{lr}) \quad = 100(500) \quad = \$50,000 \qquad \text{(eq. 16)}$$
$$C_S = 0 + 525 + 0 + 50,000 \quad = \$50,525$$
$$C_{total} = \$42,500 + \$8,500 + \$50,525 \quad = \$101,525$$

B. 31316 Broad Beach Road

Figure 15 Cost Example 31316 Broad Beach

1. Research
   a. EEI determined from site survey and aerial photography that the dispersal system will be placed primarily under hardscape.
2. Data Acquired from Research and Calculations
   a. Number of Bedrooms n_B=6 bdrm
   b. Design Flow Per Bedroom Q_B=300 gpd/bdrm
   c. Dispersal Field Application Rate D_A=1.2 gpd/sf
   d. Treatment System T_M=ES25
   e. Dispersal Area Active A_A=A_{lr}=1,500sf
   f. Dispersal Area Future A_F=1,500sf
   g. Area of landscape to be removed A_l=400sf

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h. Area of Hardscape to be removed A_h=1,100sf

3. Calculations

$$C_e = \$35,000$$
$$C_i = 1.5(35,000) \quad = \$52,500$$
$$C_E = C_e + C_i \quad = \$35,000 + \$52,500$$
$$= \$87,500$$
$$C_D = \text{cost of dispersal field equipment and installation}$$
$$= 17\ \$/ft^2 (A_A) \quad = 17(1,500) \quad = \$25,500$$
$$C_S = \text{cost of site work for OSTS installation}$$
$$= C_l + C_h + C_{sr} + C_{lr}$$
$$C_l = 0$$
$$C_h = \text{cost of removal of hardscape}$$
$$= 15\ \$/ft^2 (A_h) \quad = 15(1,100) \quad = \$16,500$$
$$C_{sr} = 0$$
$$C_{lr} = \text{cost of replacement of hardscape and landscape}$$
$$= 100\ \$/ft^2 (A_{lr}) \quad = 100(1,500) \quad = \$150,000 \quad \text{(eq. 17)}$$
$$C_S = \$16,500 + \$150,000 \quad = \$166,500$$
$$C_{total} = \$87,500 + \$25,500 + \$166,500 \quad = \$279,500$$

C. 31322 Broad Beach Road

Figure 16 Cost Example 31322 Broad Beach

1. Research
   a. EEI determined from site survey and aerial photography that the dispersal system could be placed primarily under landscaping.
2. Data Acquired from Research and Calculations
   a. Number of Bedrooms n_B=4 bdrm
   b. Design Flow Per Bedroom Q_B=300 gpd/bdrm
   c. Dispersal Field Application Rate D_A=1.2 gpd/sf

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d. Treatment System T_M=ES12
e. Dispersal Area Active $A_A = A_{lr}$ =1,000sf
f. Dispersal Area Future A_F=1,000sf
g. Area of landscape to be removed A_l=0sf
h. Area of Hardscape to be removed A_h=538sf
i. Area of Structures to be removed A_{sr}=462sf

3. Calculations

$$
\begin{aligned}
C_e &= \$22,000 \\
C_i &= 1.5(22,000) \quad = \$33,000 \\
C_E &= C_e + C_i \quad = \$22,000 + \$33,000 \\
&= \$55,000 \\
C_D &= \text{cost of dispersal field equipment and installation} \\
&= 17\ \$/ft^2 (A_A) \quad = 17(1,000) \quad = \$17,000 \\
C_S &= \text{cost of site work for OSTS installation} \\
&= C_l + C_h + C_{sr} + C_{lr} \\
C_l &= 0 \\
C_h &= \text{cost of removal of hardscape} \\
&= 15\ \$/ft^2 (A_h) \quad = 15(538) \quad = \$8,070 \\
C_{sr} &= \text{cost of removal of structures} \\
&= 40\ \$/ft^2 (A_{sr}) \quad = 40(462) \quad = \$18,480 \\
C_{lr} &= \text{cost of replacement of hardscape and landscape} \\
&= 100\ \$/ft^2 (A_{lr}) \quad = 100(1,000) \quad = \$100,000 \\
C_S &= \$8,070 + \$18,480 + \$100,000 \quad = \$126,550 \\
C_{total} &= \$55,000 + \$17,000 + \$126,550 \quad = \$198,550
\end{aligned}
\tag{eq. 18}
$$

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SECTION 9- CONCLUSIONS

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Connection to TWPCP was ruled out due to lack of capacity. Installation and connection to a centralized treatment plant (similar to TWPCP) was ruled out due to lack of available area to site the plant, construction impacts (installation of miles of pipe to and from the plant), and effluent distribution area (code still applies to dispersal of effluent so no net saving in area). Waterless toilet technology was ruled out due to excessive maintenance, unsanitary operation, unreliable performance, and inability to mandate properties to utilize technology. Individual on-site treatment system for each property was selected because the technology is accepted by the City, the units are maintained by certified personnel not the property owner, the unit selected is reliable and meets City effluent restrictions for beach front properties, and the system are mandated by the City so property owners will be required to upgrade.

SCENARIO ONE

Design scenario one resulted in the possibility of the rock revetment from 31100 Broad Beach east, to the end of BBGHAD properties, to be moved further landward.

SCENARIO TWO

Design scenario two resulted in the possibility of the rock revetment from 30924 Broad Beach west to be moved further seaward and from 30924 Broad Beach east to be moved further landward.

It is our opinion that Scenario One is a short term solution and may cause unintended consequences, such as adverse effects on real estate market conditions and future permitting problems with the City of Malibu and potentially other agencies. In certain examples, the implementation of Scenario One may prevent or severely limit future development at certain sites within the project area, and thereby potentially causing adverse real estate market effects. All properties must comply with City code when they change ownership, repairs are made to existing system, or the structure is remodeled. If the rock revetment was moved landward from 31100 Broad Beach west the property owners would be limited in their ability to remodel their homes. They would also not be able to upgrade or repair their existing on-site wastewater systems. These significant effects may likely have adverse real estate market effects.

COST OF BRINGING CURRENT OSTS TO LCP/LIP STANDARDS

Based on calculations performed as part of Section 8-, page 59 the cost to bring the individual OSTS systems to current LCP/LIP standards (not including installation of expansion dispersal area) is estimated at:

1. Total Cost $17,011,145

2. Minimum Cost $101,000
3. Maximum Cost $334,000
4. Average Cost $212,639

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SECTION 10- REFERENCES

[1] California Coastal Commission, "City of Malibu Local Coastal Program, Local Implementation Plan," California Coastal Commission, 2002.

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APPENDIX A

Engineering Plans
Calculation Sheets

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APPENDIX B

Property Research Documents

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APPENDIX C

References

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