UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 9
75 Hawthorne Street
San Francisco, CA 94105

CITY AND COUNTY OF HONOLULU'S HONOULIULI WASTEWATER TREATMENT PLANT APPLICATION FOR A MODIFIED NPDES PERMIT UNDER SECTION 301(h) OF THE CLEAN WATER ACT	TENTATIVE DECISION OF THE REGIONAL ADMINISTRATOR PURSUANT TO 40 CFR PART 125, SUBPART G

I have reviewed the attached evaluation analyzing the merits of the application of the City and County of Honolulu's request for the Honouliuli Wastewater Treatment Plant and ocean outfall variance from secondary treatment requirements of the Clean Water Act (the Act) pursuant to section 301(h). It is my tentative decision that the Honouliuli Wastewater Treatment Plant and ocean outfall be denied a variance in accordance with the terms, conditions and limitations of the attached evaluation, based on section 301(h) of the Act.

My decision is based on available evidence specific to this particular discharge. It is not intended to assess the need for secondary treatment in general, nor does it reflect on the necessity for secondary treatment by other publicly owned treatment works discharging to the marine environment.

Under the procedures of the Permit Regulations, 40 CFR Part 124, public notice and comment regarding this tentative decision will be made available to interested persons. Following the public comment period on this tentative decision, a final decision will be issued under the procedures in 40 CFR Part 124.

Dated: 27 MARCH 2007

Wayne Nastri
Regional Administrator

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INTRODUCTION

The City and County of Honolulu (CCH), Hawaii (the applicant) has requested a renewal of its variance[1] under section 301(h) of the Clean Water Act (the Act), 33 U.S.C. section 1311(h), from the secondary treatment requirements contained in section 301(b)(1)(B) of the Act, 33 U.S.C. section 1311(b)(1)(B).

The variance is being sought for the Honouliuli Wastewater Treatment Plant (HWWTP), a publicly owned treatment works (POTW). The applicant is seeking a 301(h) variance to discharge wastewater receiving less-than-secondary treatment to the Pacific Ocean. Secondary treatment is defined in regulations (40 CFR Part 133) in terms of effluent quality for total suspended solids (TSS), biochemical oxygen demand (BOD) and pH. Pursuant to 40 CFR Part 133.102, the secondary treatment requirements for TSS, BOD and pH are listed below:

TSS: (1) The 30-day average shall not exceed 30 mg/l.
(2) The 7-day average shall not exceed 45 mg/l.
(3) The 30-day average percent removal shall not be less than 85%.

BOD: (1) The 30-day average shall not exceed 30 mg/l.
(2) The 7-day average shall not exceed 45 mg/l.
(3) The 30-day average percent removal shall not be less than 85%.

pH: The pH of the effluent shall be maintained within the limits of 6.0 to 9.0 pH units.

This document presents the EPA Region 9's findings, conclusions, and recommendations as to whether the applicant's proposed discharge will comply with the criteria set forth in section 301(h) of the Act, as implemented by regulations contained in 40 CFR Part 125, Subpart G.

DECISION CRITERIA

Under section 301(b)(1)(B) of the Act, 33 U.S.C. section 1311(b)(1)(B), POTWs in existence on July 1, 1977, were required to meet effluent limitations based upon secondary treatment as defined by the Administrator of EPA (the Administrator). Secondary treatment has been defined by the Administrator in terms of three parameters: TSS, BOD, and pH. Uniform national effluent limitations for these pollutants were promulgated and included in National Pollutant Discharge Elimination System (NPDES) permits for POTWs issued under section 402 of the Act. POTWs were required to comply with these limitations by July 1, 1977.

Congress subsequently amended the Act, adding section 301(h) which authorizes the Administrator, with State concurrence, to issue NPDES permits which modify the

[1] A 301(h) variance from secondary treatment is sometimes informally referred to as a "waiver."

secondary treatment requirements of the Act with respect to certain discharges. P.L. 95-217, 91 Stat. 1566, as amended by, P.L. 97-117, 95 Stat. 1623; and section 303 of the Water Quality Act (WQA) of 1987. Section 301(h) provides that:

> The Administrator, with the concurrence of the State, may issue a permit under section 402 [of the Act] which modifies the requirements of subsection (b)(1)(B) of this section [the secondary treatment requirements] with respect to the discharge of any pollutant from a publicly owned treatment works into marine waters, if the applicant demonstrates to the satisfaction of the Administrator that:
>
> (1) there is an applicable water quality standard specific to the pollutant for which the modification is requested, which has been identified under section 304(a)(6) of this Act;
>
> (2) such modified requirements will not interfere, alone or in combination with pollutants from other sources, with the attainment or maintenance of that water quality which assures protection of public water supplies and the protection and propagation of a balanced, indigenous population (BIP) of shellfish, fish and wildlife, and allows recreational activities, in and on the water;
>
> (3) the applicant has established a system for monitoring the impact of such discharge on a representative sample of aquatic biota, to the extent practicable, and the scope of the monitoring is limited to include only those scientific investigations which are necessary to study the effects of the proposed discharge;
>
> (4) such modified requirements will not result in any additional requirements on any other point or nonpoint source;
>
> (5) all applicable pretreatment requirements for sources introducing waste into such treatment works will be enforced;
>
> (6) in the case of any treatment works serving a population of 50,000 or more, with respect to any toxic pollutant introduced into such works by an industrial discharger for which pollutant there is no applicable pretreatment requirement in effect, sources introducing waste into such works are in compliance with all applicable pretreatment requirements, the applicant will enforce such requirements, and the applicant has in effect a pretreatment program which, in combination with the treatment of discharges from such works, removes the same amount of such pollutant as would be removed if such works were to apply secondary treatment to discharges and if such works had no pretreatment program with respect to such pollutant;
>
> (7) to the extent practicable, the applicant has established a schedule of activities designed to eliminate the entrance of toxic pollutants from nonindustrial sources into such treatment works;

(8) there will be no new or substantially increased discharges from the point source of the pollutant to which the modification applies above that volume of discharge specified in the permit;

(9) the applicant at the time such modification becomes effective will be discharging effluent which has received at least primary or equivalent treatment and which meets the criteria established under section 304(a)(1) of the Clean Water Act after initial mixing in the waters surrounding or adjacent to the point at which such effluent is discharged.

For the purposes of this subsection the phrase "the discharge of any pollutant into marine waters" refers to a discharge into deep waters of the territorial sea or the waters of the contiguous zone, or into saline estuarine waters where there is strong tidal movement and other hydrological and geological characteristics which the Administrator determines necessary to allow compliance with paragraph (2) of this subsection, and section 101(a)(2) of this Act. For the purposes of paragraph (9), "primary or equivalent treatment" means treatment by screening, sedimentation and skimming adequate to remove at least 30 percent of the biochemical oxygen demanding material and of the suspended solids in the treatment works influent, and disinfection, where appropriate. A municipality which applies secondary treatment shall be eligible to receive a permit pursuant to this subsection which modifies the requirements of subsection (b)(1)(B) of this section with respect to the discharge of any pollutant from any treatment works owned by such municipality into marine waters. No permit issued under this subsection shall authorize the discharge of sewage sludge into marine waters. In order for a permit to be issued under this subsection for the discharge of a pollutant into marine waters, such marine waters must exhibit characteristics assuring that water providing dilution does not contain significant amounts of previously discharged effluent from such treatment works. No permit issued under this subsection shall authorize the discharge of any pollutant into marine estuarine waters which at the time of application do not support a balanced, indigenous population of shellfish, fish and wildlife, or allow recreation in and on the waters or which exhibit ambient water quality below applicable water quality standards adopted for the protection of public water supplies, shellfish and wildlife, or recreational activities or such other standards necessary to assure support and protection of such uses. The prohibition contained in the preceding sentence shall apply without regard to the presence or absence of a causal relationship between such characteristics and the applicant's current or proposed discharge. Notwithstanding any of the other provisions of this subsection, no permit may be issued under this subsection for discharge of a pollutant into the New York Bight Apex consisting of the ocean waters of the Atlantic Ocean westward of 73 degrees 30 minutes west longitude and westward of 40 degrees 10 minutes north latitude.

EPA regulations implementing section 301(h) provide that a 301(h)-modified NPDES permit may not be issued in violation of 40 CFR 125.59 (b), which requires among other

things, compliance with the provisions of the Coastal Zone Management Act (16 U.S.C. 1451 *et seq.*), the Endangered Species Act (16 U.S.C. 1531 *et seq.*), the Marine Protection Research and Sanctuaries Act (16 U.S.C. 1431 *et seq.*), and any other applicable provision of State or Federal law or Executive Order. In the following discussion, data submitted by the applicant are analyzed in the context of the statutory and regulatory criteria.

SUMMARY OF FINDINGS

Based upon review of data, references, and empirical evidence furnished in the application and other relevant sources, EPA Region 9 makes the following findings with regard to compliance with the statutory and regulatory criteria:

1. The applicant's proposed discharge will comply with primary treatment requirements. [Section 301(h)(9); 40 CFR 125.60]

2. The applicant's proposed discharge will comply with the State of Hawaii's water quality standards for dissolved oxygen, suspended solids, and pH. [Section 301(h)(1); 40 CFR 125.61]

3. The applicant has not shown that it can consistently achieve state water quality standards or water quality criteria beyond the zone of initial dilution. [Section 301(h)(9); 40 CFR 125.62(a)(1)(i), 122.4(d)]

4. The applicant's proposed discharge, alone or in combination with pollutants from other sources, will not adversely impact public water supplies. However, the applicant's proposed discharge will interfere with the protection and propagation of a balanced, indigenous population (BIP) of fish, shellfish, and wildlife, and the applicant's proposed discharge will negatively impact recreational activities. [Section 301(h)(2); 40 CFR 125.62(b), (c), (d)]

5. The applicant did not propose a new monitoring program and the existing monitoring program is not sufficient. [Section 301(h)(3); 40 CFR 125.63]

6. It does not appear that the applicant's proposed discharge would result in any additional treatment requirements on any other point or nonpoint source. [Section 301(h)(4); 40 CFR 125.64]

7. The applicant's existing pretreatment program was approved by EPA on July 29, 1982, and remains in effect. However, the applicant has not demonstrated that its users are in compliance with pretreatment requirements and that it will enforce them. The applicant has proposed a non-industrial source control program that is basically an educational effort to inform the public about nonpoint and wastewater issues and household toxic control measures. [Section 301(h)(5), (6), (7); 40 CFR 125.65, 125.66, 125.67.]

8. The applicant proposes no new or substantially increased discharges from the point source of the pollutants to which the 301(h) variance will apply above those specified in the current permit. [Section 301(h)(8); 40 CFR 125.67]

9. The applicant has not yet provided determinations or concurrences from the Hawaii Office of Planning of the Department of Business, Economic Development and Tourism that the applicant's discharge is consistent with the State's Coastal Zone Program; from the National Oceanic and Atmospheric Administration that the applicant's discharge is in accordance with Title III of the Marine Protection, Research and Sanctuaries Act, 16 USC 1431 *et seq*.; or m the U.S. Fish and Wildlife Service and NOAA's National Marine Fisheries Service that the discharge is likely not to adversely affect listed threatened or endangered species or habitat. [40 CFR 125.59(b)(3)]

10. While the State of Hawaii would have to concur in issuance of a final 301(h) modified NPDES permit and make specific determinations regarding compliance with water quality standards and whether the discharge would result in additional requirements on other sources, no State concurrence or determination is necessary at this time because the tentative decision is that a modified NPDES permit not be issued. [40 CFR 125.59(b)(3), 125.61(b)(2), 125.64(b)]

CONCLUSION

It is concluded that the applicant's proposed discharge will not comply with the requirements of section 301(h) and 40 CFR 125, Subpart G, and the water quality conditions of the Hawaii Administrative Rules, Title 11, Chapter 54.

RECOMMENDATION

It is recommended that the applicant be denied its request for a section 301(h) variance in accordance with the above findings pursuant to the applicable provisions of 40 CFR Parts 122-125. The basis for this recommendation is discussed below.

DESCRIPTION OF TREATMENT SYSTEM

Background

The original 301(h) application for a variance from secondary treatment at the Honouliuli Wastewater Treatment Plant (HWWTP) was submitted to EPA on September 7, 1979. In January 1982, the HWWTP began discharging to marine waters under an NPDES permit issued by the Hawaii Department of Health (HDOH) for secondary treatment, although treated effluent from the plant was considered less than primary. In September 1981, a tentative decision on the 1979 application granted a variance for BOD but denied a variance for TSS. This decision prompted CCH to submit a reapplication on October 31, 1983 requesting reconsideration of the TSS variance denial based on improved primary treatment. Based on the reapplication, EPA issued a Tentative Decision Document dated April 4, 1988 recommending the 301(h) variance be granted.

In accordance with the 1988 Tentative Decision Document (TDD) approving CCH's variance, the current 301(h)-modified National Pollutant Discharge Elimination System (NPDES) permit was issued by EPA on May 2, 1991, became effective on December 16, 1993, and expired on June 5, 1996. This permit has been administratively extended since the expiration date. An application to reissue the discharge permit was submitted on December 1, 1995, at least 180 days prior to the permit expiration, and updated in January 2000. The application was updated again on August 30, 2004. In this tentative decision document, references to the application refer to the August 2004 document.

The following description of the treatment system is based on the applicant's 2004 permit application and submittals provided in response to EPA's requests for additional information. The applicant provided additional information, including flow diagrams of the current treatment process and a facility layout plan, in three submittals (Houghton, 30 December 2004 letter; Takamura, 21 January 2005 letter; Takamura, 15 April 2005 letter).

Treatment System

Construction of the Barbers Point deep ocean outfall, which serves the Honouliuli WWTP, was completed in February 1979. The Barbers Point outfall structure and design capacity, 112 million gallons per day (MGD) maximum flow, have not changed since they were described in the 1983 reapplication. The characteristics of the outfall and diffuser are summarized in Table 1. Treated effluent is discharged through the existing Barbers Point outfall located in approximately 61.0 m (200 ft) of water approximately 2,670 m (8,760 ft) from shore, at 21° 17' 06" N latitude and 158° 01' 41.4" W longitude.

Currently, the HWWTP treats wastewater from the collection system, permitted liquid-waste-hauler discharges, and sludge hauled by the City and County of Honolulu from the Wahiawa and Paalaa Kai wastewater treatment plants. Approximately 27 MGD of raw wastewater is treated at the HWWTP at the present time. There are no combined sewers in the system. Wastewater from the service area, which serves a population of

approximately 340,000 including the towns of Waipahu, Pearl City, and Halawa, is primarily domestic. The application indicates three Significant Industrial Users (SIUs) that contribute to the HWWTP.

Since the 1983 reapplication, the average annual HWWTP design flow increased from 1.1 to 1.7 cubic meters per second (25 to 38 MGD). The Honouliuli WWTP was built in phases. The first phase of the Honouliuli plant was built to a primary treatment level (30% removal of TSS and BOD) with a design capacity of 25 MGD. A plant expansion was completed in December 1992, increasing the liquid treatment capacity of the plant to 51 MGD with the addition of two primary clarifiers, for a total of four primary clarifiers. Currently, the facility provides primary treatment at a design flow capacity of only 38 MGD because one clarifier serves as a backup and is generally offline. In the application, the design flow of the Honouliuli treatment plant is described as 38 MGD.

The HWWTP is designed to provide primary treatment consisting of influent screening, grit removal, pre-aeration, primary sedimentation, and effluent screening. The application indicates that discharged effluent is not disinfected.

Upon entering the Honouliuli facility, the influent wastestream flows past the influent sampler, bar screens, and flow meter. The wastestream is then split into two primary treatment channels, or treatment trains, denoted as PC1 and PC2 in the facility layout plan (Figure 1). Each channel flows through separate pre-aeration and grit chambers. Each channel contains two primary treatment clarifiers, although only one of the clarifiers associated with PC2 is operated at any given time. After wastewater moves through the primary clarifiers, effluent from PC1 is sent to the secondary treatment process described below, while effluent from PC2 is sent directly to the effluent forebay for ocean disposal. Final effluent flows past the effluent flow meter then to the ocean outfall. As discussed below, varying amounts of more highly treated wastewater (i.e., secondary and tertiary treated effluent) are sent to the effluent forebay of the Honouliuli facility for discharge to the ocean along with the primary treated effluent.

In 1996, construction at the Honouliuli facility was completed on a secondary treatment plant designed to treat up to13 MGD. This secondary facility, which was added to the primary treatment facility, became operational in September 1996. The secondary treatment plant was originally designed to fulfill effluent reuse requirements under State Department of Health Consent Order 89-CW-EOW-6, dated June 1993.

Up to 13 MGD of primary treated effluent from PC1 flows to the secondary treatment process. The secondary treatment facility contains two biotowers, four solids contact/reaeration tanks, and two secondary final clarifiers. Effluent from the secondary treatment process either flows to the tertiary treatment plant or to the effluent forebay, depending on the need to recycle water for reuse.

The solids handling facility is integrated between the primary and secondary treatment facilities. The current solids treatment capacity is estimated by the applicant to be sufficient to process solids produced by an influent flow of up to 29 MGD. The

application indicates that construction to upgrade the solids handling capacity was scheduled to be completed in 2006; however, construction had not yet begun on this facility as of February 2007.

Solids are subjected to gravity thickening, heat treatment, and dewatering. Primary sludge is thickened in gravity thickener tanks then blended with secondary sludge in blend tanks. The combined primary and secondary sludge is then processed through a heat treatment (Zimpro) unit. The thickened, heated sludge is pumped to the decant tank. From the decant tanks, the sludge is sent to a different compartment within the blend tank and eventually to the centrifuge for dewatering. Centrate from the centrifuge is returned to PC2. Dewatered sludge is trucked to the Waimanalo Gulch landfill for disposal or to the Barbers Point compost operation. Honouliuli currently produces about 5,000 metric tons of sewage sludge per year.

In September 2000, construction was completed on a tertiary treatment facility designed to process up to 12 MGD of secondary treated effluent by filtration and reverse osmosis (RO). RO water is defined as water that has passed through a semi permeable membrane. R-1 water is defined by HDOH as water that has been oxidized, filtered, and disinfected to meet standards set in Hawaii Administrative Rules (HAR) 11-62-26. R-1 water is a high quality classification, but below the quality of RO water. Water described in this document as tertiary treated water can be either RO or R-1 if not noted. Effluent leaving the tertiary treatment facility meets the State's standards for recycled water.

The tertiary facility was constructed to fulfill a Supplemental Environmental Project under the applicant's May 1995 Consent Decree, 94-00765 DAE, with HDOH and EPA. The tertiary plant is currently owned by the City and County of Honolulu's Board of Water Supply. Tertiary treated water is used to irrigate golf courses and to supply feed water for industrial use at the Campbell Industrial Park. Tertiary treated water that is not reused is sent back to the effluent forebay of the Honouliuli facility for discharge to the ocean along with the primary treated effluent. Brine and tertiary filter backwash, by-products of the reverse osmosis process, are returned to the preaeration chamber in PC2.

Altered Discharge

An altered discharge is defined in 40 CFR section 125.58(b) as all changes that result in a treatment level less than that currently achieved, including changes in effluent volumes or composition. CCH is applying for an altered discharge. The applicant is seeking an altered discharge because the proposed 30-day average limit for BOD is higher than the previous limit and current performance.

The applicant is seeking a variance from the secondary treatment requirements for BOD and TSS, but the applicant is not seeking a variance for pH. The applicant's proposed effluent limits for BOD and TSS, along with the current limits and the range of current performance, are listed in Table 2.

CCH has indicated that they might discharge various combinations of primary, secondary, and tertiary treated effluent, brine from reverse osmosis, and filter backwash from the tertiary treatment process under a 301(h)-modified permit. The application indicates that the City may intermittently discharge excess reclaimed effluent to the outfall. The discharge may include secondary effluent, RO water, R-1 water, and brine. EPA requested clarification of how the applicant was proposing to operate the treatment facilities. The applicant responded by describing six possible operating scenarios (Takamura, 15 April 2005 letter). These scenarios are presented in Table 3.

The various operating configurations would result in different effluent volumes and qualities. In order to evaluate the application, EPA tried to evaluate which configuration would be the worst case in order to ensure that under any of the potential scenarios, the 301(h) requirements would be met. The analysis was limited, however, by a lack of data in the application on the quality of the various waste streams. For example, conceptually, it is likely that the brine discharge could contain significant amounts of toxic pollutants. Thus, configuration 3 might well be the worst case. However, there was no data on the quantities of toxic pollutants in the brine. Therefore, EPA based its evaluation on either the effluent quality proposed in the application (e.g., 200 mg/L BOD as a monthly average) or on existing monitoring data. EPA notes that where existing monitoring data was used, it is likely reflective of a higher quality effluent than would be produced under some of the operating configurations proposed by the applicant. For example, configuration 1, all primary treatment, would likely have higher pollutant concentrations than a mix of primary and secondary effluents, as has historically occurred at HWWTP.

Projected effluent flow rates, based on anticipated population increases and development within the service area, are given in Tables II.A.2-3 and Table II.A.4-1 of the application and summarized in Table 4. The applicant's projections are based on the assumption that all flows to the treatment plant will be discharged and none will be reused (scenario #1 from Table 3 in this document).

TSS mass loading totalled approximately 1530 metric tons/year in 2005 and 1620 metric tons/year in 2006.

The applicant is not seeking a variance for pH. The secondary treatment requirement for pH is that effluent values shall be maintained within the limits of 6.0 to 9.0 [(40 CFR 133.102(c)]. EPA reviewed discharge monitoring report (DMR) entries for effluent pH values from June 1991 through December 2006. All pH values recorded on DMRs ranged between 6.22 and 8.02, except for a four-month period in 1992-93 and an eight-month period in 1994. During the 1992-93 period, effluent pH ranged from 5.1 to 5.46. During the 1994 period, minimum reported pH readings ranged from 5.37 to 5.88 in five of the eight months. In the application, CCH states that violations from May through August 1994 were the result of illegal discharges from industrial sources.

With the exception of these two periods, pH values in the effluent met permit limits. Based on primary treated effluent, the applicant presented projected effluent values for pH values in 2010, 2015 and 2020. For all years, the minimum projected pH value was

6.0 and the maximum projected value was 9.0. These estimates are drawn from and in accordance with NPDES permit limits for pH. They are also consistent with the secondary treatment requirements for pH.

DESCRIPTION OF RECEIVING WATERS

Description of Shoreline and Ocean Bottom off Ewa Plain

The application contains the following description:

> The ocean bottom in the vicinity of the outfall is composed of a wide, predominantly flat calcium carbonate (limestone) platform, which is an erosional remnant of the extensive, geologically ancient emergent reef that forms the Ewa Plain. The distance from the shoreline to the 20 meters depth contour is approximately 2 kilometers, indicating that the bottom topography has a very gentle slope. Sloping gradually increases from the shoreline out to well beyond the 100 meter depth contour. The surface of this reef platform is relatively barren, characterized by short algal turf cover and a layer of sediment composed of sand. In some area, shallow sand-filled channels intersect the reef platform resulting in a limited groove and ridge system. In some of the deeper areas, there are extensive sand deposits. The nearshore area has a rather solid limestone bottom, averaging about 35 percent coverage, while sand and rubble cover approximately 62 percent of the area surveyed by the Ewa Marine Biological Monitoring Program. This is characteristic of the nearshore regions. Offshore, the entire ocean floor consists of sand and rubble.

Hydrographic Conditions

The Barbers Point ocean outfall is located in West Mamala Bay, midway between Pearl Harbor and Barbers Point. The circulation in this part of the bay is complex, with a tidal convergence close to the outfall.[2] Semi-diurnal and diurnal tides are the principal circulation component within the bay. This tidal influence is modified by a permanent westward flow generated by the Pacific North Equatorial Current. The current generally flows in a westerly direction through the Hawaiian Islands and is part of the cyclonic circulation of the North Pacific. As a result, Mamala Bay waters are also influenced by wind forcing, propagation of long period waves and circulation in deep offshore coastal waters.

According to the Mamala Bay Study, the semi-diurnal tide wave, moving in a southwesterly direction, appears to split near the North Shore of Oahu, creating two progressive tide waves. One propagates along the east side of the island and the other

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[2] A summary of the oceanographic conditions and circulation in Mamala Bay is provided in this document, and referenced from the 1995 application, the Mamala Bay Commission Study (1996) and other recent studies from University of Hawaii.

along the west side. Coastal trapping causes these two waves to curve around the headlands at Barbers Point and Diamond Head and to merge within Mamala Bay before continuing toward the southwest. As a result, strong tidal velocities measured at Barbers Point and Diamond Head are then oriented parallel to the depth contours and directed toward the middle of the bay. Weak currents are a result of merging flows from opposite directions. Converging flows at flood tide cause a downwelling at the center of the bay, which reverse with the tidal cycle at ebb tide. Consequently, large changes in stratification occur over the tidal cycles, with the water column often becoming homogeneous at different sites. This is a critical factor in predicting the transport and fate behavior of the effluent plume.

Diurnal tides are observed to be relatively uniform in amplitude throughout the bay and propagated principally from east to west. Consequently, the combination of semi-diurnal and diurnal tides vary significantly at different places in the bay, with semi-diurnal tides dominating at Barbers Point and Diamond Head, and diurnal tides dominating in the center of the bay. Both tidal components are generally directed parallel to the depth contours.

Mamala Bay Studies reveal relatively weak local correlation of winds with sea level and current at sampling sites in the center of the bay. Analyses also revealed a general weakening of the westward flows on the shelf with weakening of the trade winds from the northwest. There was little or no evidence of wind forcing effects in shallow nearshore areas, which has implications for plume transport and fate. Instead, analysis of temperature fluctuations revealed a strong dependence of circulation within the bay on the large-scale oceanographic processes in the ocean surrounding the island.

Physically, the Kahipa-Mamala shelf extends to a depth of approximately 107 m (350 ft) and varies offshore up to 5.8 km (3.6 mi) from the Pearl Harbor channel to just southwest of Barbers Point. The Barbers Point ocean outfall diffuser lies on this shelf at a maximum depth of about 61 m (200 ft) and begins 2.1 km (1.3 mi) offshore.

Precipitation falling over the urbanized drainage basins leads to elevated nutrient and sediment levels in Mamala Bay, which are discharged into the bay through drainage courses like Pearl Harbor. According to the applicant, over half of the entire Mamala Bay runoff, which covers approximately 572 km^2 (221 mi^2), drains into the Pearl Harbor lochs. The freshwater discharge through the mouth of Pearl Harbor also contains 7.5 MGD of secondary treated sewage from Fort Kamehameha WWTP.

Stratification

The applicant indicates that maximum stratification occurs during the late summer and early fall months from August to October and minimum stratification occurs during the winter months between January and March. The degree of stratification will determine whether the discharge plume above the diffuser section will remain submerged or surface. During the summer months, the mixed-layer depth varied from 42 m to 61 m (140 to 200 ft), and to 91 m (300 ft) or more during winter months. Diurnal changes in

stratification were also noticed and thought to be the result of insolation patterns. The surface layer thickness increased during the early afternoon with a subsequent decrease by nightfall. Density profiles at the outfall for both maximum and minimum stratifications are greater during the spring than during the fall months but always above 1.02 g/cm^3. The applicant reported that the average density of the Honouliuli wastewater is 0.99 g/cm^3.

Current Speed and Direction

Current measurements during test years were made in the winter and summer at depths of approximately 9 m (30 ft), 27 m (90 ft) and 58 m (190 ft). Current velocity distributions were determined by grouping data into 10 cm/sec (0.33 ft/sec) intervals. The mid-interval speed for the slowest group was 5 cm/sec (0.16 ft/sec). Only during the winter at the 9 m station did the 10-percentile current speeds exceed 5 cm/sec. For mid-depth measurements, the summer and winter 10-percentile current speeds are approximately 4 cm/sec (0.13 ft/sec) and 2.5 cm/sec (0.08 ft/sec), respectively. EPA averaged the two mid-depth summer and winter measurements and applied the average (3.2 cm/sec) in initial dilution calculations (see section discussing initial dilution). Current roses in the application show a dominance of east-west currents near the surface and at mid-depth. Near the bottom, flow was predominantly to the south or southwest. Current roses at the three depths are displayed in Figures D-6, D-7, and D-8 of the application.

Recreational Uses

Recreational activities reported by the applicant in the area potentially affected by the Honouliuli discharger (Barbers Point Beach to Fort Kamehameha Beach) include picnicking, fishing, surfing, swimming, diving, and boating. The edible seaweed ogo is gathered along the reef runway of the Honolulu International Airport at depths of less than 3 m (9 ft). The applicant states that most water contact activities generally occur within 457 m (1,500 ft) of shore in depths less than 8 m (25 ft).

In 2003, the applicant employed a research firm to conduct a survey measuring usage of the Oahu south shore by island residents and to determine how the recreational area is used (Ward Research, 2003). The survey results confirmed that residents participated in recreational activities in ocean waters out to two miles from shore and beyond. Residents identified recreational activities including swimming, snorkeling, sailing, boating, fishing, diving, surfing/bodyboarding/windsurfing, paddling/canoeing/kayaking, and waterskiing. Thirty-four percent of the 375 respondents reported frequent recreational use (defined in the study as use at least once every other week) of the south shore. While the majority recreational activity reported in this survey took place within 91 m (300 feet) of shore, recreational use beyond two miles from shore was reported by at least five percent of the respondents.

Coral Reefs

Coral reefs are common in Hawaiian waters at depths of less than 36.6 m (120 ft). The island of Oahu is surrounded by a fringing reef ecosystem. The Honouliuli outfall diffuser is situated seaward of the fringing reef. Available information suggests that there are no extensive coral reefs within about 700-1,000 m (2,300–3,300 ft) of the discharge site. Small patches of coral (primarily *Montipora*) may occur in deep water of Mamala Bay, and species of black coral also live at these depths.

Fisheries

In the application, CCH reported that recreational and commercial fishing in the vicinity of the Honouliuli outfall occurs within a very large area designated by the Hawaii Department of Land and Natural Resources in 1979 as statistical area 401, an area which the applicant notes is used by an estimated 9.6 percent of Oahu's inshore fishermen. Statistical area 421, located offshore from area 401, is preferred by 8.4 percent of offshore fishermen. Thus, a substantial portion of Oahu's commercial fishing occurs in the general vicinity of the Honouliuli outfall.

The most important commercial fish species captured in statistical areas 401 and 421 include bigeye scad *(Selar crumenophthalmus*), grey snapper (*Lutianus griseus*), jack crevalle (*Caranx hippos*), goatfishes (Mullidae), skipjack tuna (*Euthynnus pelamus*), yellowfin tuna (*Thunnus albacares*), marlin (*Makaira* sp.), and mahi-mahi (primarily *Coryphaeha hippurus*). Of these eight types of fishes, only goatfishes and grey snapper are common near reefs, and only goatfishes were found near the outfall. Because the remaining types of fishes are generally pelagic, few would be expected to occur near the discharge site for an extended period of time. The applicant indicated over 68,000 pounds of fishes were landed from statistical area 401 in 1994. The applicant did not present the weight for more recent years.

PHYSICAL CHARACTERISTICS OF THE DISCHARGE

Outfall/Diffuser and Initial Dilution

40 CFR 125.62(a) requires that the proposed outfall and diffuser must be located and designed to provide adequate initial dilution, dispersion, and transport of wastewater to meet all applicable State water quality standards and EPA water quality criteria at and beyond the boundary of the zone of initial dilution (ZID). This evaluation is based on conditions occurring during periods of maximum stratification and during other periods when discharge characteristics, water quality, biological seasons, or oceanographic conditions indicate more critical situations may exist. The physical characteristics of the Honouliuli outfall and diffuser are summarized earlier in Table 1.

Figure 2 provides a graphical description of a wastefield generated by a simple ocean outfall. The Amended Section 301(h) Technical Support Document (1994) provides the following description of initial dilution and dispersion:

> As the plume rises and entrains ambient saline water, its density increases and its momentum and buoyancy decrease accordingly. If a sufficient ambient vertical density gradient or zone of stratification (like a pycnocline or a thermocline) is present, the plume will spread horizontally at the level of neutral buoyancy (i.e., where the plume density equals ambient water density). If a sufficient density gradient is not present, the diluted effluent will reach the water surface and flow horizontally. The vertical distance from the discharge points to the centerline of the plume when it reaches the level of neutral buoyancy or the water surface is called the "height-of-rise" (sometimes referred to as the height to "trapping" or "equilibrium" level). The dilution achieved at the completion of this process is called the "initial dilution." Dilution is the ratio of the total volume of a sample (ambient water plus effluent) to the volume of effluent in the sample. A dilution of 100 is a mixture composed of 99 parts of ambient water and 1 part of effluent.

Initial dilution is a critical parameter relative to compliance with State and Federal water quality standards and criteria. The lowest (i.e. critical) initial dilution must be computed for each of the critical environmental periods. The predicted peak 2- to 3-hour effluent flow for the new end-of-permit year, a temperature and salinity depth profile of the receiving water, and current speed no higher than the lowest 10 percentile are applied in a mathematical model to compute the critical initial dilution.

The applicant calculated initial dilution for maximum and minimum stratification conditions using the EPA-approved mathematical model DOS PLUMES (Baumgartner et al., 1994). The applicant's seasonal initial dilutions and trapping levels are presented in Table III.A.1-3 of the application. Monthly effluent flow data from 1994 were used by the applicant to predict monthly maximum peak hourly flow estimates for the years 2000, 2005, and 2010. Using the model, the applicant applied these predicted flow estimates, ambient current speeds ranging from 1.6 to 6.0 cm/sec, and temperature and salinity profiles taken on the following dates: July 2, 1993; December 2, 1993; January 10, 1994; and April 14, 1994. These four profiles are intended by the applicant to represent each season. These depth profiles were collected from station HZ in the receiving water. Station HZ is located above the diffuser, in the center of the zone of initial dilution. Therefore, temperature and salinity profiles taken from this site portray the receiving water after it has already been influenced by the plume as opposed to the receiving water in a less altered state.

Results for the 16 combinations of end-of-permit maximum peak hourly effluent flow and these seasonal receiving water profiles are shown in the printouts of initial dilution computations presented in Appendix F of the 301(h) application. The applicant's modeling predicted maximum stratification to occur in the winter, when the trapping depth is 48 meters below the surface. A corresponding minimum initial dilution of **210:1** was computed by the applicant. This value is based on the maximum peak hourly effluent flow predicted for March 2010 (61.05 MGD), the temperature and salinity depth profile recorded on January 10, 1994 at station HZ, and an ambient current speed of 2.4 cm/sec for readings from the top 28 meters of the water column and 5.4 cm/sec for

readings below 28 meters. The applicant also predicted other critical periods to occur in the months of June and August when the plume is predicted to surface due to low-density stratification.

The applicant's proposed initial dilution for the Honouliuli discharge was recalculated by EPA using the EPA-approved model Visual Plumes (Frick et al., 2003), which supersedes EPA's DOS PLUMES modeling system. Using the same predicted end-of-permit maximum peak hourly effluent flow, temperature and salinity depth profiles, and current speeds applied by the applicant in Visual Plumes, EPA predicted the initial dilution to be 216:1 at the trapping depth of 47 meters. This analysis shows there is general agreement between the two models.

The four profiles applied by the applicant assessed only a limited number of environmental situations, which decreased the opportunity to identify one of the most critical environmental conditions in the receiving water. In order to determine the critical initial dilution for the Honouliuli discharge from a more comprehensive and representative collection of receiving water conditions, EPA assessed a total of 27 receiving water temperature and salinity depth profiles. This collection included the four profiles from 1993 and 1994 already assessed by the applicant, four profiles from the early 1970s submitted in Table III.A.1-2 of the application, and 19 profiles recorded by the applicant from station HB6 and reported to EPA in DMRs between February 2000 and November 2005. Station HB6 was chosen because it is representative of the receiving water conditions near the diffuser but not so close that temperature and salinity readings are influenced by the effluent plume. Seven profiles reflecting the receiving waters in the winter season were assessed in conjunction with estimated maximum peak hourly flows for January, February, and March of 2012. Similarly, seven profiles reflecting the receiving waters in the spring season were assessed using estimated flows for April, May, and June of 2012; seven profiles reflecting receiving waters in the summer season were assessed in conjunction with estimated flows for July, August, and September; and six profiles from the fall season were assessed in conjunction with the predicted flows for October, November, and December of 2012. A mid-depth current speed of 3.2 cm/sec was applied throughout. This is the average of summer (4 cm/sec) and winter (2.5 cm/sec) mid-depth current speeds described in the application. Prior to use in the Visual Plumes model, some of the temperature and salinity depth profiles were edited so the resulting density profiles contained no instabilities. This practice was also applied to the dilution calculations in the last variance review for CCH's Sand Island wastewater treatment plant.

In this review, the temperature and salinity depth profile producing the lowest (i.e. critical) initial dilution is from August 30, 2000. With this profile, combined with the estimated end-of-permit flow of 2.19 m^3/sec (49.94 MGD) for July 2012 representing the highest estimated flow for the summer season, and the mid-depth current speed of 3.2 cm/sec, EPA calculated the most critical environmental situation. The Visual Plumes model computed the critical initial dilution of **118:1** at a trapping depth of 51 meters

below the surface.[3] EPA uses the computed dilution ratio of 118:1 throughout this 301(h) review as the critical short-term initial dilution for the Honouliuli discharge.

EPA also used the Visual Plumes model to evaluate the relative diluting effect of brine on the performance of the Honouliuli outfall. The model predicted only a negligible effect with the addition of up to 2 MGD of brine combined with at least 14 MGD of primary treated effluent. Additional information provided by the applicant indicates that the amount of brine currently added to the effluent is no greater than approximately 925 gpm (1.3 MGD). Therefore, the addition of brine resulting from the tertiary treatment process is not considered to have a significant impact on the resulting buoyancy of the plume and is not assessed further in this review.

Application of Initial Dilution to Water Quality Standards

Numeric water quality standards for toxic pollutants listed in Hawaii Administrative Rules (HAR) 11-54-4(b)(3) provide acute and chronic criteria to protect aquatic life and fish consumption criteria to protect human health. This list also identifies toxic pollutants that are carcinogens. In accordance with HAR 11-54-4(b)(3) and the HDOH State Toxics Control Program: Derivation of Water Quality-Based Discharge Toxicity Limits for Biomonitoring and Specific Pollutants (1989), minimum dilution is used when comparing toxic pollutant concentrations in effluent discharges through a submerged outfall to numeric chronic toxicity standards and numeric human health fish consumption standards for non-carcinogens. The average dilution value is used when comparing toxic pollutant concentrations in effluent discharges through a submerged outfall to numeric human-health fish consumption standards for carcinogens.

In Appendix J (Priority Pollutants and Pesticide Discussion) of the application, CCH presented a dilution value of **228:1**. This is the dilution value (i.e. average dilution value) applied by the applicant in its assessment of priority toxic pollutants and pesticides in Appendix J. The application states that this value was calculated by CCH's consultant for the 1995 Honouliuli 301(h) NPDES application. In the 2004 application (page 8 of Appendix J), CCH indicated that their method for developing this value had not changed since the 1995 application. Therefore, CCH applied the 228:1 value to concentrations of priority toxic pollutants and pesticides reported in the effluent. In other sections of the application where the critical initial dilution (i.e. minimum) is required (e.g. dissolved oxygen or turbidity calculations), the applicant applied its critical initial dilution of **210:1**.

As discussed earlier, EPA calculated the critical (i.e. minimum) initial dilution to be 118:1. Additionally, in accordance with HAR 11-54-4(b)(4) and the HDOH State Toxics Control Program, EPA calculated an average dilution for the Honouliuli discharge using the Visual Plumes model. In the model, EPA applied the average current speed of 3.2 cm/sec and the estimated average annual flow of 1.65 m^3/sec (37.68 MGD) for the end-

[3] *If the highest estimated flow, 62.27 MGD for March 2012, is applied in the model with the most critical profile, the resulting initial dilution does not vary much. Using the July 2012 estimated flow, the model predicts an initial dilution of 118 at the trapping depth of 51 meters; using the March 2012 estimated flow, the model predicts an initial dilution of 120 at the trapping depth of 51 meters.*

of-permit year 2012 to each of the 27 temperature and salinity depth profiles previously described. The geometric mean of all these 27 initial dilution values was calculated to be 412. 412:1 is used by EPA as the average dilution value. The estimated average annual flow of 37.68 MGD is essentially the same for purposes of calculating initial dilution, as the design flow of 38 MGD, which the HDOH State Toxics Control Program requires for development of the average dilution value.

Therefore, in this review by EPA, the minimum (i.e., critical) initial dilution of **118:1** will be applied to chronic and fish consumption criteria for non-carcinogens, and the average dilution of **412:1** will be applied to fish consumption criteria for carcinogens, such as chlordane and dieldrin. The critical initial dilution of 118:1 will also be applied in the sections of this review discussing turbidity, DO, and whole effluent toxicity.

Zone of Initial Dilution

The zone of initial dilution (ZID), as defined in 40 CFR 125.58(dd), refers to the region of initial mixing surrounding or adjacent to the end of the outfall pipe or diffuser ports, provided that the ZID may not be larger than allowed by mixing zone restrictions in applicable water quality standards. The Amended Section 301(h) Technical Support Document (ATSD) operationally delimit this volume of water in relation to the depth of the outfall (i.e., subtending the depth of the outfall on each side of the diffuser and above it). The ZID dimensions, calculated by the applicant to be a rectangle parallel to the 231° azimuth, are 122 m (400 ft) wide and 660 m (2,165 ft) long, centered over and parallel to the diffuser. This calculation is consistent with EPA's guidance.

40 CFR 125.62(a) requires that the applicant's outfall and diffuser be located and designed to provide adequate initial dilution, dispersion, and transport of wastewater such that the discharge does not exceed, at and beyond the ZID, all applicable water quality standards and, for pollutants for which there are no EPA-approved standards, section 304(a) criteria. HAR Chapter 11-54-9 allows a zone of mixing (ZOM), which is a limited area around outfalls to allow for initial dilution of waste discharges. Although Hawaii's water quality standards allow narrative and numeric criteria to be met at the ZOM for secondary treated effluent, 301(h) regulations require facilities with variances from secondary treatment to meet water quality standards and criteria at the ZID. Nevertheless, the HWWTP permit contains a ZOM situated around the ZID. Dimensions of the ZOM are 610 m (2,000 ft) wide and 1,128 m (3,700 ft) long.

Dilution Water Recirculation

Under section 303(e) of the WQA, before a 301(h) permit may be issued for discharge of a pollutant into marine water, such marine waters must exhibit characteristics assuring that the water providing dilution does not contain significant amounts of previously discharged effluent from the treatment works.

The applicant does not address this topic in the application. However the probability of re-entrainment at the Honouliuli outfall is low, and the effect on effluent dilution very

small, given the presence of a net current to the southwest of 2 - 6 cm/s (0.07 - 0.20 ft/sec). In order for a portion of a previously created wastefield to be entrained into a rising effluent plume, a significant portion of the wastefield must be below the lower boundary created by the rising plume.

In general, for constant environmental conditions, the plume height of rise decreases with increasing current speed (Muellenhoff et al. 1985). Because of this fact, it is necessary that the previously created wastefield enter the receiving water during a period of relatively high current flow, travel away from the diffuser, and travel back to the diffuser as the current reverses, and then be entrained into the rising plume during a period of low current speed. In such a case, the net effect of the reduction of initial dilution at low current speeds is of the order of a few percent. This is because of the high dilution achieved during the initial phase by faster currents, and the subsequent farfield dilution due to horizontal and vertical diffusion before the wastefield is entrained into the rising plume. Therefore, in Honouliuli's case, it is estimated that the receiving waters do not contain significant concentrations of previously discharged effluent.

APPLICATION OF STATUATORY AND REGULATORY CRITERIA

A. Compliance with Primary Treatment Requirements

CWA Section 301(h)(9) was amended by Section 303(d)(1) and (2) of the Water Quality Act in 1987. Under section 303(d)(1) of the WQA, the applicant's wastewater effluent must be receiving at least primary treatment at the time its 301(h) permit becomes effective. Section 303(d)(2) of the WQA states that, "Primary or equivalent treatment means treatment by screening, sedimentation, and skimming adequate to remove at least 30% of the biological oxygen demanding material and other suspended solids in the treatment works influent, and disinfection, where appropriate." 40 CFR 125.60 requires the applicant to perform monitoring to ensure, based on the monthly average results of the monitoring, that the effluent it discharges has received primary or equivalent treatment. Although the NPDES permit contains both weekly and monthly discharge limits and monitoring requirements, 301(h) regulations require 30% removal on a monthly basis for TSS and BOD. Therefore, this review focuses on monthly removal rates.

According to Metcalf and Eddy (1991), the typical composition of weak, medium, and strong untreated domestic wastewater for TSS is 100 mg/L, 220 mg/L, and 350 mg/L, respectively; the typical composition of weak, medium, and strong untreated domestic wastewater for BOD is 110 mg/L, 220 mg/L, and 400 mg/L, respectively. Efficiently designed and operated primary sedimentation tanks should remove from 50 to 70% of the TSS and 25 to 40% of the BOD.

EPA's review of DMR data for the period from 1991 through 2006 shows that monthly primary treatment requirements were met, except for four months from May through August 1994. However, EPA notes during most of this period that primary treatment

requirements for TSS and BOD removal were met under a treatment train configuration that is not simply screening, sedimentation, and skimming (i.e., primary treatment), but which also included blends of the waste streams resulting from secondary and tertiary treatment processes.

Table 5 contains a summary of monthly TSS and BOD removal rates entered on DMRs from June 1991 through December 2006, excluding the period from November 2000 through October 2003 when accurate and certified data were not reported on DMRs. Monthly removal rates ranged from 53 to 95% for TSS. These values show that the 30% monthly average removal requirement was met for TSS. However, monthly removal rates ranged from 25 to 85% for BOD. The BOD removal rates for the four-month period from May through August 1994 were less than 30%. Otherwise, BOD removal rates for the final effluent were greater than 30%.

A more detailed review of removal rates for TSS and BOD reveals a marked improvement after the secondary treatment plant began operating in September 1996. From October 1996 through September 2000 (when the tertiary treatment plant began operating), secondary treated effluent was mixed with primary treated effluent in the effluent forebay before discharge to the ocean outfall. After primary and secondary effluents were mixed, samples of the final effluent were collected by an automated sampler for laboratory analyses. Before the secondary treatment facility began operating, monthly average removal rates for TSS ranged from 66 to 84% for the period from June 1991 through August 1996. After the secondary treatment plant began processing up to 13 mgd of primary treated effluent, monthly average removal rates for TSS increased to a range from 84 to 95% during the period from October 1996 through September 2000. As previously described, with just primary treated effluent, the minimum requirement for 30% removal of TSS was met. With the addition of secondary treated effluent to the primary treated effluent, the removal rate for TSS improved.

Likewise, removal rates for BOD ranged from 25 to 60% before the secondary treatment facility started operating in September 1996. After operation of the secondary treatment plant began, the removal rates for BOD increased to a range from 51 to 85% during the period from October 1996 through September 2000. As shown in 1994, with only primary treated effluent, the minimum requirement for 30% removal of BOD was not always met. With the addition of secondary treated effluent to the primary treated waste stream, the removal rate for BOD improved and was always above 30%.

The tertiary treatment plant was completed in September 2000. Because there was no demand for secondary treated effluent to make RO or R-1 water until the tertiary treatment plant was constructed, during the period from September 1996 through September 2000, all secondary treated effluent flowed to the effluent forebay where it mixed with the primary treated effluent prior to discharge. Final effluent monitoring conducted after the effluent forebay and just prior to discharge to the outfall reflected this mixture of primary and secondary treated effluent.

Removal rates appear to have dropped slightly after the tertiary treatment plant was completed in September 2000, but this point cannot be clearly determined by EPA because the applicant did not provide removal rates on DMRs from November 2000 through October 2003. Consequently, it is not possible to determine if there were immediate effects from this change in treatment and change in the volumes of primary, secondary, and tertiary treated effluents discharged.

As previously described, from October 1996 through September 2000, monthly average TSS removal rates ranged from 84 to 95%, and the applicant did not submit accurate and certified DMR data from November 2000 through October 2003 (as discussed under section C.1.c of this document). From November 2003, when the applicant resumed submitting accurate and certified DMR data, through December 2006, the range of monthly average removal rates for TSS decreased to between 53 and 89%. During this period, all secondary treated effluent flowed to either the tertiary plant or the outfall.

As previously described, from October 1996 through September 2000, monthly average BOD removal rates ranged from 51 to 85%. From November 2003 through December 2006, when a steady supply of secondary and tertiary treated effluent was no longer reliably available for mixing with the primary effluent, the range of monthly average removal rates for BOD decreased to between 32 and 60%. These marked changes in removal rates show that the addition of more highly treated wastewater dilutes TSS and BOD concentrations in the primary treated effluent, thereby improving the quality of treated wastewater that is discharged to the receiving water. When the amount of more highly treated wastewater for mixing with the primary treated effluent is reduced, TSS and BOD removal rates decline.

In 1993, the first year when the applicant provided influent TSS and BOD concentrations in DMR reports, the annual average influent concentration was 242 mg/L for TSS and 229 mg/L for BOD. By 2006, the annual average influent concentration had increased to 300 mg/L for TSS and 290 mg/L for BOD, with the highest annual average influent concentrations observed at 361 mg/L for TSS and 298 mg/L for BOD. Without the addition of more highly treated wastewater, it is doubtful that primary treatment alone could regularly meet the requested monthly average effluent limit for BOD of 200 mg/L.

Based on data provided by the applicant, EPA observes that the two sets of primary clarifiers provide different quality effluent. PC1 consists of two clarifiers operated in parallel. The total wastewater flow through PC1 is divided between the two clarifiers in this set. Up to 13 mgd of primary treated effluent from PC1 flows to the secondary treatment plant. There are two clarifiers in PC2; however, only one clarifier is operated at a time and the other is held as a backup. Additionally, high BOD centrate from the sludge dewatering process is returned to PC2. Primary treated effluent from PC2 flows directly to the effluent forebay where it is mixed with primary treated effluent from PC1, secondary treated effluent, and/or tertiary treated effluent and their waste streams–and then to the ocean outfall. For these reasons, EPA requested the applicant to provide effluent data related to TSS and BOD for each set of primary clarifiers. In response to EPA’s request, the applicant provided additional data in letters dated July 7, 2005;

August 4, 2005; and September 7, 2005 (Takamura). This additional information included TSS and BOD data for both primary channels for the period from May 15 through August 15, 2005. Summaries of these data are listed in Tables 6 and 7.

EPA's review of these data indicates that TSS and BOD removal rates are lower for PC2 than for PC1. For the month of June 2005, the TSS concentration in the primary treated effluent was 50 mg/L from PC1 and 57 mg/L from PC2. Accordingly, the TSS removal rate was 85% for PC1 and 82% for PC2. The BOD concentration in the primary effluent was 154 mg/L from PC1 and 213 mg/L from PC2. The BOD concentration from PC2 is greater than the current monthly average permit limit of 160 mg/L. The removal rate was 47% for PC1 and only 27% for PC2. The BOD removal rate for PC2 alone is less than the monthly average requirement of 30%.

Similar results were measured for the month of July 2005. Although the TSS concentration in the primary effluent was 55 mg/L from PC1 and 55 mg/L from PC2, there was a greater difference seen in the BOD values. The BOD concentration in the primary effluent was 161 mg/L from PC1 and 210 mg/L for PC2. The BOD removal rate for PC1 was 42% but just 24% for PC2. Again, the BOD concentration from PC2 is greater than the monthly average permit limit of 160 mg/L and the BOD removal rate for PC2 alone is less than the monthly average requirement of 30%.

In its application, CCH is proposing a higher 30-day average limit for BOD than the limit in its existing permit and higher than its current performance. The application is not based on a specific treatment scenario, but the applicant does not rule out the possibility of discharging only primary effluent from PC1 and PC2, along with tertiary treatment process waste streams, during the term of the next permit. EPA views the discharge of primary effluent plus brine, as the likely worst-case scenario. If the applicant could discharge only PC2 effluent, then it is likely that the discharge would not meet the proposed BOD limit of 200 mg/L or the 30% removal requirement, but EPA's understanding is that it is not reasonably possible for the HWWTP to discharge PC2 effluent only, given the volume of flow at HWWTP, the capacity of PC2, and the configuration of the treatment plant. Thus, configuration 3 is the likely worst-case scenario.

Based on past performance and the proposed critical operating scenario, EPA concludes that the 30% removal requirement for BOD is currently being met and would be met during the term of a renewed modified permit; however, BOD levels in the treatment plant would have to be closely monitored to ensure the 30% removal requirement for BOD is achieved even during the worst-case scenario for plant operations.

B. Attainment of Water Quality Standards for BOD and Turbidity

Under 40 CFR 125.61(a), which implements section 301(h)(1), there must be a water quality standard applicable to the pollutants for which the modification is requested and, under 125.61(b)(1), the applicant must demonstrate that the proposed modified discharge will comply with these standards.

The applicant has requested modified requirements for BOD, which affects DO, and suspended solids, which affects the turbidity or light attenuation in the receiving waters and can affect the benthos by eventually settling onto the seabed. The State of Hawaii has established water quality standards for DO and turbidity in HAR Chapter 54, Title 11, Water Quality Standards, Department of Health, 2004.

The waters of Mamala Bay are classified by the State of Hawaii as Class A open coastal waters. The protected designated uses in this class are recreational, aesthetic enjoyment and the support and propagation of fish, shellfish, and wildlife. For Class A open coastal waters, the State has two sets of water quality standards: a "wet" set applies when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile; and, a "dry" set applies to open coastal waters which receive less than three million gallons per day of fresh water per shoreline mile per day.

Prior to the year 2000, the State of Hawaii applied the "dry" set of criteria based on the historical trend of freshwater discharge per day per shoreline mile in the coastal waters off Ewa Beach. In 2000, the CCH modified the receiving water designation off the Ewa Plain from "dry" to "wet" in the City's Water Quality Management Plan (WQM or 208 Plan). The basis of the modification was the volume of fresh water discharged from the Pearl Harbor Estuary through springs and perennial streams, using stream flow data as far back as 1981. The HDOH reviewed the freshwater discharge assessments and approved the modification on December 11, 2000. The "wet" designation affects turbidity criteria, which are discussed in this section, and nutrient criteria, discussed in section C.1.d. of this document.

1. Dissolved Oxygen

In order to qualify for a variance from secondary treatment standards for BOD, 40 CFR 125.61(b)(1) requires the applicant to demonstrate that the modified discharge will comply with State water quality standards for BOD or DO. The Hawaii water quality standards at HAR 11-54-6(b)(3) require that DO in Class A open coastal waters shall not be less than 75% of saturation, determined as a function of ambient water temperature and salinity.

The existing permit requires quarterly monitoring (continuous depth profiles) for DO at 16 monitoring stations: four ZID stations (HB2-HB5), four ZOM stations (HM1-HM4), one within-ZID station located over the diffuser (HZ), one station beyond the ZOM (HB6), one upcoast reference station (HB1), one downcoast reference station (HB7), and four nearshore stations (HN1-HN4). Compliance with State water quality standards for DO applies at the edge of the ZID, in accordance with 40 CFR 125.62(a).

<u>Present Discharge</u>

The application includes annual assessment summaries of DO data for nearshore and offshore monitoring events conducted from 1994 through 2003. These annual assessment summaries for DO concentrations were submitted each year as part of the annual

assessment report (AAR) of receiving waters, which is required by the permit. The submitted to EPA from 1997 through 2005 also contain concentration-temperature-density (CTD) depth profiles for ZID, ZOM, nearshore, and reference stations. Additionally, the applicant provided EPA with an electronic database containing CTD data from 2000 through 2006.

A CTD depth profile contains basic water column data taken from the surface to the bottom of the water column at each meter of depth. These data include conductivity, pH, temperature, salinity, and DO readings. The capacity of water to contain DO is dependent on the temperature and salinity of the water. Warmer water can hold less oxygen than cooler water, and water with a higher salinity can hold less oxygen than water with a lower salinity. The highest DO concentration that water can hold (i.e., the DO saturation concentration) can be calculated from temperature and salinity values. The ATSD provides Table B-4 (Dissolved Oxygen Saturation Values) to aid this calculation.

To adhere to Hawaii's water quality standards, which determine DO as a function of ambient temperature and salinity, it is necessary to calculate the DO saturation concentration from ambient temperature and salinity values. The annual assessment summaries for DO prior to 2004 do not clearly indicate how the applicant calculated DO saturation. The 2004 AAR was the first report to indicate that ambient salinity and temperature values were based on average measurements from control stations HB1 and HB7 at each depth. DO concentration tables (but not the table given in the ATSD) were used by the applicant to calculate the DO saturation concentration for the average ambient temperature and salinity at each depth. The measured DO at each station and depth was then compared to the calculated DO concentration equal to 75% of the saturation concentration of the corresponding depth at the reference stations. The applicant's practice of developing a DO saturation concentration based on reference station data, which represent ambient conditions, conforms to Hawaii's water quality standards. HAR 11-54-1 defines "ambient conditions" as the water conditions that would occur in the receiving water if these waters were not influenced by the proposed new human activity.

There were 41 monitoring events from 1994 and 2003. The annual report summaries contained in the application indicated that monitoring for all years from 1994 through 2003, with the exception of 2002, met the 75% saturation limit. The DO summary for 2002, included in the application and drawn from the 2002 AAR, indicates that five monitoring events were conducted in that year. These events were conducted in February, March, April, July, and October. The summary indicates that the minimum measured DO concentrations in July and October 2002 did not meet the 75% saturation requirement for DO. In July, the minimum measured concentration was 5.135 mg/L, and 75% of the DO saturation value for that monitoring event was reported as 5.294 mg/L. In October, the minimum measured concentration was 5.190 mg/L, and 75% of the DO saturation value for that monitoring event was reported as 5.439 mg/L. The applicant does not indicate which stations or depths exceeded the DO water quality standard.

Based on these results, the Hawaii water quality standard for DO was not met in two of the 41 (5%) quarterly monitoring events conducted from 1994 through 2003.

EPA reviewed the applicant's electronic database of CTD data for receiving water monitoring events conducted from 2000 through 2006. To determine the DO saturation concentration at the upcurrent reference station, HB1, EPA averaged ambient temperature and salinity values for each of three groups of depths at HB1. The surface group included water column data collected from 1 to 22 meter depths, the middle portion included depths from 23 to 44 meters, and the bottom portion included depths from 45 to 68 meters. Based on averages of measured temperature and salinity readings from each depth (surface, middle, and bottom), EPA calculated the DO saturation concentration for each depth at reference station HB1 and the corresponding 75% saturation concentration for each depth. For the years from 2000 to 2006, DO saturation concentration values for all three depths ranged from 6.90 to 7.15 mg/L at HB1, and the corresponding 75% values ranged from 5.18 to 5.36 mg/L. All measured DO concentrations for each monitoring station at the ZID and ZOM were then compared to the 75% DO concentration at the corresponding depth of the reference station HB1, which represents the ambient condition specified in the Hawaii water quality standard. For the seven-year period reviewed, the lowest recorded DO reading was 5.32 mg/L at the bottom depth of site HB5 in the September 2002 monitoring event. The calculated ambient concentration at the reference station on this date and for this depth was 5.25 mg/L. Therefore, the lowest recorded reading in 2002 was greater than the corresponding ambient concentration, and the State water quality standard was met. All other DO readings during this seven-year period achieved the ambient 75% concentration for DO. The exceedance that was identified by the applicant in the October 2002 monitoring results did not appear to be a true exceedance based on EPA's assessment, due to the more detailed method of determining ambient conditions.

Nearshore stations were also compared to the 75% saturation concentration developed based on reference station (HB1) temperature and salinity averages for each depth. All DO concentrations recorded at nearshore stations met the Hawaii water quality standard for DO.

EPA's review indicated that all ZID, ZOM, beyond ZOM, and nearshore stations met the Hawaii water quality standard for DO.

Projected Discharge

The applicant used predictive equations and models in the ATSD to evaluate the potential effect of the discharge on ambient DO concentrations compared to Hawaii water quality standards. In order to evaluate compliance of the proposed discharge with the Hawaii water quality standard for DO, projected receiving water DO levels are calculated in four environmentally critical situations:

a. at the boundary of the zone of initial dilution (ZID)
b. farfield (beyond the ZID)
c. near the bottom due to steady sediment demand, and
d. near the bottom due to abrupt sediment resuspension.

Results of these analyses are compared to the Hawaii water quality standard requiring DO concentrations to be above 75 percent of saturation, determined as a function of ambient water temperature and salinity.

a. Dissolved Oxygen Concentration Upon Initial Dilution

The dissolved oxygen concentration immediately following critical initial dilution, at the boundary of the ZID, is calculated using ATSD Equation B-5:

$$DO_f = DO_a + [(DO_e - IDOD - DO_a) / S_a]$$

where:

DO_f = Final dissolved oxygen concentration of the receiving water at the plume trapping depth, in mg/L

S_a = Initial dilution

IDOD = Immediate dissolved oxygen demand, in mg/L

DO_e = Dissolved oxygen concentration of the effluent, in mg/L

DO_a = Ambient dissolved oxygen concentration, immediately upcurrent of the diffuser, averaged from the diffuser port depth to the plume trapping depth, in mg/L

The applicant and EPA have relied on this equation to predict the final DO concentration of the receiving water at the plume trapping depth, following critical dilution at the boundary of the ZID (DO_f).

A discussion of critical initial dilution and how this value is determined can be found in previous sections of this document. For initial dilution (S_a), the applicant used a critical initial dilution value of 210. In this evaluation, EPA used the recalculated critical initial dilution value of 118, as previously described in this document. Because the initial dilution process occurs rapidly (on the order of minutes), BOD exertion, a relatively slow process, is negligible during this period. However, immediate dissolved oxygen demand (IDOD), representing the oxygen demand of reduced substances in the effluent that are rapidly oxidized (e.g., sulfide to sulfate), may not be negligible. The ATSD states that IDOD values for sewage treatment plant effluents typically vary from 0 to 10 mg/L. Using ATSD Table B-3, the applicant and EPA chose an IDOD value of 5 mg/L for the

Honouliuli effluent, estimated based on: primary treatment, an effluent BOD_5 value of 200 mg/L, and a travel time from the treatment plant through the diffuser of 100 minutes.

According to the ATSD, effluent dissolved oxygen (DO_e) at the point of discharge from sewage treatments plants is often 0.0 mg/L. Consequently, the applicant and EPA have assumed a worst-case DO_e value of 0.0 mg/L.

For ambient dissolved oxygen (DO_a), the applicant calculated a value of 5.848 mg/L. For this evaluation, EPA calculated a DO_a value of 6.15 mg/L, by averaging the 11 ambient DO readings sampled at upcurrent reference station HB1—at 1 meter intervals from the depth of the diffuser (61 meters) to the trapping depth (51 meters)—in August 2000.

Returning to ATSD Equation B-5, using the described input values, the applicant projected a final dissolved oxygen concentration in the receiving water at the plume trapping depth, DO_f, of 5.796 mg/L. In this evaluation, EPA used Equation B-5 and the described input values to project a final dissolved oxygen concentration, DO_f, of 6.06 mg/L.

Dissolved oxygen saturation in ocean waters is dependent on the water's temperature and salinity. If temperature and salinity are known, then the theoretical value (in mg/L) for DO at 100 percent saturation can be determined. For example, if the water temperature is 20 ˚C and salinity is 36 parts per thousand, then the theoretical value for DO at 100 percent saturation is 7.4 mg/L. In contrast, if the water temperature is 25 ˚C and salinity is 36 parts per thousand, then the theoretical value for DO at 100 percent saturation is 7.0 mg/L. ATSD Table B-4 gives theoretical values (in mg/L) for DO at 100 percent saturation, based on ambient temperature and salinity. The Hawaii water quality standard for DO specifies that concentrations should not be not less than 75 percent saturation, based on ambient temperature and salinity. So, for example, to comply with the Hawaii water quality standard for DO, if ambient temperature and salinity are 25 ˚C and 36 parts per thousand (respectively), then a projected DO_f value (in mg/L) must fall within the range of the DO concentration at 75 percent saturation or 5.25 mg/L, and the DO concentration at 100 percent saturation or 7.0 mg/L.

In their evaluation, the applicant projected a final dissolved oxygen concentration immediately following initial dilution (DO_f) of 5.796 mg/L. Although not using ATSD Table B-4 (Dissolved Oxygen Saturation Values), the applicant used a different source and determined that the theoretical DO concentration at 100 percent saturation was 6.81 mg/L, at an ambient temperature of 24.5 ˚C and a salinity of 35 parts per thousand. (In contrast, EPA notes that ATSD Table B-4 would have yielded a theoretical DO concentration at 100 percent saturation of 7.1 mg/L.) The corresponding DO concentration at 75 percent saturation is 5.1 mg/L. The applicant concluded that compliance with the Hawaii water quality standard for DO was achieved because the projected final dissolved oxygen concentration (DO_f) of 5.796 mg/L—at 85 percent saturation—falls within the range of 75 and 100 percent saturation based on ambient temperature and salinity.

In this evaluation, EPA projected a final dissolved oxygen concentration immediately following initial dilution (DO_f) of 6.06 mg/L. Using ATSD Table B-4, at an ambient temperature of 25.5 ˚C and a salinity of 35 parts per thousand, the theoretical DO concentration at 100 percent saturation is 7.0 mg/L and the corresponding DO concentration at 75 percent saturation is 5.25 mg/L. Compliance with the Hawaii water quality standard for DO is achieved because the projected final dissolved oxygen concentration (DO_f) of 6.06 mg/L—at 87 percent saturation—falls within the range of 75 and 100 percent saturation based on ambient temperature and salinity.

b. Farfield Dissolved Oxygen Depression Due to BOD Exertion

Subsequent to initial dilution, DO in the water column is consumed by biochemical oxygen demand (BOD) in the drifting wastefield. BOD consists of two components, a carbonaceous component (CBOD) and a nitrogenous component (NBOD).
CBOD measures the oxidation of carbonaceous compounds and NBOD measures the oxidation of nitrogenous compounds. Both of these components can contribute to oxygen depletion in the farfield. This section evaluates whether farfield BOD exertion in the wastefield causes a violation of the Hawaii water quality standard for DO.

Both the applicant and EPA have relied on the following simplified mathematical model developed by Brooks (1960) to predict farfield dissolved oxygen as a function of travel time, DO(t), in the Honouliuli wastefield as it drifts in the coastal waters of Mamala Bay (ATSD, Equation B-16):

$$DO(t) = DO_a + [(DO_f - DO_a) / D_s] - (L_{fc} / D_s)(1 - \exp[-k_c t]) - (L_{fn} / D_s)(1 - \exp[k_n t])$$

where:

$DO(t)$ = Dissolved oxygen concentration in a submerged wastefield as a function of travel time, t, in mg/L

DO_a = Affected ambient dissolved oxygen concentration immediately updrift of the diffuser, in mg/L

DO_f = Dissolved oxygen concentration at the completion of initial dilution, in mg/L, calculated using ATDS Equation B-5

L_{fc} = Ultimate CBOD concentration above ambient at the completion of initial dilution, in mg/L

k_c = CBOD decay rate coefficient

L_{fn} = Ultimate NBOD concentration above ambient at the completion of initial dilution, in mg/L

k_n = NBOD decay rate coefficient

D_s = Dilution attained subsequent to initial dilution as a function of travel time

In ATSD Equation B-16, above, both ambient dissolved oxygen (DO_a) and dissolved oxygen at the completion of initial dilution (DO_f) are taken from ATSD, Equation B-5, described in the previous TDD section discussing the DO concentration upon completion of initial dilution. The applicant used a DO_a value of 5.848 mg/L and a DO_f value of 5.796 mg/L (assuming an IDOD of 5.0 mg/L). In this evaluation, EPA used a DO_a value of 6.15 mg/L and a DO_f value of 6.06 mg/L (assuming an IDOD of 5.0 mg/L).

According to the ATSD, nitrogenous BOD (NBOD) might not always contribute to oxygen depletion if the discharge is to open coastal waters where there are no other major discharges in the vicinity and the background population of nitrifying bacteria is negligible. Consequently, in this evaluation, the applicant and EPA have assumed that all oxygen depletion occurs in the first phase of the BOD reaction due to carbonaceous BOD (CBOD) and that the effect of NBOD on farfield oxygen depletion is negligible. Based on this assumption, the long-term (ultimate) CBOD (L_{fc}) can be estimated. Using ATSD, Equations B-10 and B-11, long-term (ultimate) BOD (BOD_{fu}) is first calculated and then set equal to L_{fc}, as shown in the following two equations:

$$BOD_f = BOD_a + (BOD_e - BOD_a) / S_a$$

where:

BOD_f = Final BOD_5 concentration, in mg/L

BOD_a = Affected ambient BOD_5 concentration immediately updrift of the diffuser, from the diffuser port depth to the trapping depth, in mg/L

BOD_e = Effluent BOD_5 concentration, in mg/L

S_a = Initial dilution (flux-averaged)

and:

$$L_{fc} = BOD_{fu} = BOD_f \times 1.46$$

where:

BOD_{fu} = Ultimate BOD at the completion of initial dilution, in mg/L

The applicant indicated that ambient BOD (BOD_a) is generally very low in ocean waters and assumed 0 mg/L for this value. Based on the worst-case monthly maximum effluent BOD (BOD_e) value of 238 mg/L and a critical initial dilution (S_a) of 210, the applicant calculated final BOD (BOD_f) at the completion of initial dilution as 1.13 mg/L. The

applicant then converted BOD_f to the ultimate BOD (BOD_{fu}) value of 1.65 mg/L, by multiplying 1.13 mg/L and the constant 1.46. Because the applicant assumed that all oxygen depletion occurs in the first phase of the BOD reaction due to CBOD only, the ultimate COD (L_{fc}) value is set equal to the BOD_{fu} value of 1.65 mg/L.

In this analysis, EPA also assumed a value of 0 mg/L for BOD_a. Based on the proposed limit for effluent BOD (BOD_e) of 200 mg/L and a critical initial dilution (S_a) of 118, EPA calculated BOD_f at the completion of initial dilution as 1.69 mg/L. EPA then converted BOD_f to the ultimate BOD_{fu} value of 2.47 mg/L, by multiplying 1.69 mg/L and the constant 1.46. Because EPA assumed that all oxygen depletion occurs in the first phase of the BOD reaction due to CBOD only, the ultimate COD (L_{fc}) value is set equal to the BOD_{fu} value of 2.47 mg/L.

Returning to ATSD Equation B-16, because the carbonaceous BOD decay rate coefficient (k_c) is temperature dependent, the applicant recalculated a k_c value of 0.28/day at 24.5 ˚C using ATSD Equation B-13:

$$k_c = 0.23 \times 1.047^{(T - 20\,^\circ C)}$$

where:

T = Ambient receiving water temperature (˚C)

In this analysis, EPA also used Equation B-13 to calculate a k_c value of 0.30/day at 25.5 ˚C, where 25.5 ˚C is the receiving water temperature at the trapping depth, at upcurrent reference station HB1 in August 2000.

Returning to ATSD Equation B-16, the value(s) for farfield dilution subsequent to initial dilution as a function of travel time (D_s) must now be calculated using ATSD Equations B-21 and B-18:

$$D_s = \mathit{erf}\ 1 / [1.5 / [1 + (12\ e_0\ t / b^2)^{\ 2} - 1]^{\ 1/2}]$$

and:

$$e_0 = 0.001 \times b^{4/3}\ ft^2/sec$$

where:

e_0 = Diffusion coefficient when the width of the sewage wastefield at any distance from the ZID is equal to the initial width (approximately the longest dimension of the ZID) of the wastefield, in feet

t = Travel time, in seconds

b = Initial width of the sewage wastefield (approximately as the longest dimension of the ZID), in feet

erf = Error function

For this calculation, the applicant specified that the initial width of the sewage wastefield (b) was 2,000 feet. In this analysis, EPA used the longest dimension of the ZID (b), 2176 feet, to calculate a diffusion coefficient (e_0) of 28.04 ft^2/sec.

Now D_s, can be calculated for time intervals corresponding to the fall velocities of the particles in the wastestream. As shown in part below, the applicant ran an hourly time series for 1 to 72 hours post initial dilution to calculate the corresponding values for D_s:

t_1 = 1 hour, D_s = 0.658
t_2 = 2 hours, D_s = 1.010
t_3 = 3 hours, D_s = 1.337
t_4 = 4 hours, D_s = 1.661
t_{24} = 24 hours, D_s = 10.083
t_{48} = 48 hours, D_s = 24.686
t_{72} = 72 hours, D_s = 43.051

In this evaluation, EPA calculated the corresponding values for D_s post initial dilution, at the following time intervals:

t_1 = 1 hour, D_s = 0.623
t_2 = 2 hours, D_s = 0.930
t_3 = 3 hours, D_s = 1.196
t_4 = 4 hours, D_s = 1.444
t_{24} = 24 hours, D_s = 5.814
t_{48} = 48 hours, D_s = 10.896
t_{72} = 72 hours, D_s = 15.960

The values described and/or calculated in the previous paragraphs are now used, by the applicant and EPA, in ATSD Equation B-16 to predict farfield dissolved oxygen as a function of travel time, DO(t), where all oxygen depletion occurs in the first phase of the BOD reaction due to carbonaceous BOD:

$$DO(t) = [DO_a + ((DO_f - DO_a) / D_s)] - [(L_{fc} / D_s)(1 - \exp(-k_c\, t))]$$

The applicant reported the following time series and, based on this, concluded that the projected minimum dissolved oxygen concentration, DO(t), is 5.759 mg/L which occurs two hours following initial dilution. The applicant stated that this corresponds to a projected maximum DO depletion and deficit of 0.09 mg/L, based on a minimum ambient dissolved oxygen (DO_a) value of 5.848 mg/L.

t_1 = 1 hour, D_s = 0.658, where DO(t) = 5.740 mg/L

t_2 = 2 hours, D_s = 1.010, where DO(t) = 5.759 mg/L
t_3 = 3 hours, D_s = 1.337, where DO(t) = 5.766 mg/L
t_4 = 4 hours, D_s = 1.661, where DO(t) = 5.771 mg/L
t_{24} = 24 hours, D_s = 10.083, where DO(t) = 5.802 mg/L
t_{48} = 48 hours, D_s = 24.686, where DO(t) = 5.817 mg/L
t_{72} = 72 hours, D_s = 43.051, where DO(t) = 5.825 mg/L

Although not using ATSD Table B-4 (Dissolved Oxygen Saturation Values), the applicant used a different source and determined that the theoretical DO concentration at 100 percent saturation was 6.81 mg/L, at an ambient temperature of 24.5 ˚C and a salinity of 35 parts per thousand. (In contrast, EPA notes that ATSD Table B-4 would have yielded a theoretical DO concentration at 100 percent saturation of 7.1 mg/L.) The corresponding DO concentration at 75 percent saturation is 5.11 mg/L. The applicant concluded that compliance with the Hawaii water quality standard for DO was achieved because the projected minimum dissolved oxygen concentration, DO(t), of 5.759 mg/L—at 85 percent saturation—falls within the range of 75 and 100 percent saturation based on ambient temperature and salinity.

In this evaluation, EPA calculated the following time series and, based on this, concluded that the projected minimum dissolved oxygen concentration, DO(t), is 5.943 mg/L which occurs one hour following initial dilution. This corresponds to a projected maximum DO depletion and deficit of 0.21 mg/L, based on a minimum ambient dissolved oxygen (DO_a) value of 6.15 mg/L.

t_1 = 1 hour, D_s = 0.623, where DO(t) = 5.943 mg/L
t_2 = 2 hours, D_s = 0.930, where DO(t) = 5.977 mg/L
t_3 = 3 hours, D_s = 1.196, where DO(t) = 5.995 mg/L
t_4 = 4 hours, D_s = 1.444, where DO(t) = 6.003 mg/L
t_{24} = 24 hours, D_s = 5.814, where DO(t) = 6.029 mg/L
t_{48} = 48 hours, D_s = 10.896, where DO(t) = 6.044 mg/L
t_{72} = 72 hours, D_s = 15.960, where DO(t) = 6.056 mg/L

Using ATSD Table 6-4, at an ambient temperature of 25.5 ˚C and a salinity of 35 parts per thousand, the theoretical DO concentration at 100 percent saturation is 7.0 mg/L and the corresponding DO concentration at 75 percent saturation is 5.25 mg/L. Compliance with the Hawaii water quality standard for DO is achieved because the projected minimum dissolved oxygen concentration, DO(t), of 5.943 mg/L—at 85 percent saturation—falls within the range of 75 and 100 percent saturation based on ambient temperature and salinity.

c. DO Depression Due to Steady-State Oxygen Demand

This calculation predicts the effect of sewage solids, which have accumulated on the ocean bottom, on DO concentration in the seawater. The applicant calculated the DO depletion due to a steady sediment oxygen demand by the following equation (B-24 in the ATSD):

$$\Delta DO = \bar{S}_b X_m / 86{,}400\ UHD = a \bar{S} k_d X_m / 86{,}400\ UHD$$

where:

ΔDO	=	Oxygen depletion, mg/L
X_m	=	Length of deposition area, m
H	=	Average depth of water column influenced by sediment oxygen demand, measured above bottom, m
U	=	Minimum sustained current over deposition area, m/sec
k_d	=	Sediment decay rate constant
a	=	Oxygen:sediment stoichiometric ratio
$\bar{S}$	=	Average concentration of deposited organic sediments over the deposition area, g/m^2
D	=	Dilution caused by horizontal entrainment of ambient water as it passes over the deposition area

The applicant calculated that the DO depression due to steady state demand was 0.122 mg/L. The applicant assumed X_m is 3,000 m, H is 2.53 m, U is 0.03 m/sec, k_d is 0.01/day, a is 1.07, S is 25 g/m^2, and D is one.

From the ambient DO concentration following initial dilution, 5.796 mg/L, the applicant subtracted the amount of DO depression due to steady-state oxygen demand, 0.122 mg. This calculation yields a DO concentration of 5.674 mg/L resulting from steady-state oxygen demand. This result is 83% of saturation at 6.81 mg/L., which satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

The applicant's calculated DO depression due to steady-state demand, 0.122 mg/L, subtracted from EPA's ambient DO concentration following initial dilution, 6.06 mg/L, yields a DO concentration of 5.938 mg/L. This DO concentration is 85% of saturation at 7.0 mg/L, which satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

d. Dissolved Oxygen Depression Due to Abrupt Sediment Resuspension

The applicant calculated the DO depression due to abrupt sediment resuspension using the following equation, B-29, found in the ATSD:

$$\Delta DO = \bar{S}_r / DH\ [1 - \exp(- k_r t/24)\ ]$$

where:

ΔDO	=	Oxygen depletion, mg/L
–		

S_r	=	Average concentration (in g/m^2) of resuspended organic sediment (based on 90-day accumulation), g/m^2
H	=	Depth of water volume containing resuspended materials, m
k_r	=	Decay rate of resuspended sediments,
t	=	Elapsed time following resuspension, h
D	=	Dilution caused by horizontal entrainment of ambient water as it passes over the deposition area,

Using EPA's 1982 sediment accumulation prediction (25 g/m^2) and the methods described in the ATSD (pp. B37- B39), the applicant predicted that the DO depression due to abrupt resuspension of bottom sediments is 0.083 mg/L three hours after the resuspension event. From the ambient DO concentration, 5.796 mg/L, the applicant subtracted the amount of DO depression due to abrupt resuspension, 0.083 mg/L. This calculation yields a minimum DO concentration of 5.713 mg/l resulting from sediment resuspension. This DO concentration is 84% of saturation at 6.81 mg/L, which satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

The applicant's calculated DO depression due to abrupt resuspension of bottom sediments, 0.083 mg/L, subtracted from EPA's ambient DO concentration following initial dilution, 6.06 mg/L, yields a DO concentration of 5.98 mg/L. This DO concentration is 85% of saturation at 7.0 mg/L, which satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

Dissolved Oxygen Conclusion

The minimum DO concentration following initial dilution was calculated by the applicant to be 5.796 mg/L and by EPA to be 6.06 mg/L. These values are 85% and 87%, respectively, of the DO saturation concentration. The minimum farfield DO concentration was calculated to be 5.759 mg/L by the applicant and 5.943 mg/L by EPA. Therefore, both of these DO concentrations are 85% of saturation at 6.81 mg/L in CCH's calculations and 7.0 mg/L in EPA's calculations. This satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

The minimum DO concentrations from steady-state sediment oxygen demand and abrupt resuspension of sediments were determined by the applicant to be 5.674 mg/L and 5.713 mg/L, respectively. Neither of these values falls below the minimum allowable 75 percent of the saturation DO concentration.

Therefore, State water quality standards for DO should be met by the altered discharge. EPA concludes that the altered discharge will not significantly affect ambient DO concentrations outside the zone of initial dilution for the Honouliuli outfall. This is based on our review of the results of predictive models and ambient monitoring data.

2. Turbidity, Light Extinction Coefficient, and Suspended Solids

In order to quality for a variance from the secondary treatment standards for total suspended solids (TSS), 40 CFR 125.61(a) requires an applicant to demonstrate that the modified discharge will comply with State water quality standards for suspended solids, turbidity, light transmission, light scattering, or maintenance of the euphotic zone. There is no Hawaii water quality standard for TSS. Instead, Hawaii's water quality standards contain limits for turbidity and light extinction coefficient (LEC). In accordance with 40 CFR 125.62(a), these standards apply at the ZID.

In Hawaii's water quality standards, turbidity is stated in terms of nephelometric turbidity units (NTU) and light extinction is defined as light extinction coefficient units (k). For Class A "wet" open coastal waters:

- Turbidity values shall not exceed a geometric mean of 0.50 NTU, 10% of values shall not exceed 1.25 NTU, and 2% of values shall not exceed 2.00 NTU; and
- Light extinction coefficient (LEC) values shall not exceed a geometric mean of 0.20 k, 10% of values shall not exceed 0.50 k, and 2% of values shall not exceed 0.85 k.

The existing 301(h)-modified permit requires quarterly monitoring for turbidity and LEC at four nearshore stations (HN1-HN4) and 12 offshore stations: four ZID-boundary stations (HB2-HB5), a within-ZID station (HZ), a station beyond the ZOM (HB6), four ZOM-boundary stations (HM1-HM4), and two reference stations (HB1 and HB7). At all nearshore and offshore stations, turbidity grabs are required at the surface, mid-depth and bottom. The permit also requires the applicant to record a LEC value at each nearshore and offshore station.

<u>Present Discharge</u>

In the application, CCH provided turbidity and LEC summaries from AARs for the years from 1994 to 2003. EPA also reviewed the AARs from 2004 and 2005, which were generated after the application was submitted. In addition to the annual report summaries provided in the application, the applicant provided EPA with a database of turbidity monitoring results for the years from 1991 through 2006 and LEC values for 1992, 1993, and 2006. This database did not include ZOM-station data for turbidity.

Turbidity

In the annual assessment summaries, the applicant analyzed turbidity data on an annual (calendar year) basis. Additionally, the applicant analyzed data on a five-year basis in order to identify long-term impacts. The applicant only analyzed data from the ZID stations (i.e., data from HB6 and ZOM data were not analyzed). All turbidity values for the ZID stations were below the Hawaii water quality standard of 0.5 NTU for turbidity.

EPA reviewed the applicant's offshore turbidity data from 1991 through 2006 for all four ZID stations (HB2-HB5), the station located beyond the ZOM (HB6), and the two reference stations (HB1 and HB7). Annual geometric mean turbidity values for each depth at each station were compared to Hawaii's water quality criteria for Class A "wet" open coastal waters. The geometric mean limit of 0.50 NTU for turbidity was not exceeded in any of the annual values. Annual values at ZID stations and HB6 ranged from 0.09 to 0.28 NTU. Not-to-exceed values for 2% and 10% of the time were also assessed for the same stations and not exceeded.

Nearshore turbidity readings were higher than offshore readings. EPA calculated annual geometric mean values for turbidity at each depth in the nearshore stations from 1991 to 2006. Turbidity readings ranged from 0.12 to 0.46 NTU. The Hawaii water quality standard for turbidity was met at nearshore monitoring stations.

Light Extinction Coefficient

A Secchi disk measures the transparency of the water. When lowered into the water column, the Secchi depth marks the point where the disk is no longer visible. The applicant recorded Secchi depths at each monitoring station then used this reading to calculate the LEC value for each nearshore and offshore monitoring station. LEC values were calculated from Secchi disk depths using a proportionality constant (k_2) of 0.85 until 1994 when the constant was changed to 1.7 in the ATSD. EPA recalculated the LEC values before 1994 using the correct K_2 of 1.7.

In accordance with Equation B-54 of the ATSD, LEC is calculated as:

$$LEC = k_2/\text{Secchi depth (in meters)}$$

where the proportionality constant, k_2, is now accepted to be 1.7

The applicant presented annual report summaries from 1994 through 2003. In these summaries, annual geometric means were calculated from LEC values reported from quarterly monitoring events. The applicant reported one calculated geometric mean, which appears to represent the ZID and ZOM stations. These geometric mean values ranged from 0.02 to 0.14 k units. All values were below the Hawaii water quality standard for LEC.

EPA reviewed the annual reports for 2004 and 2005 as well as the LEC monitoring results for the years 1992, 1993, and 2006 at all ZID, ZOM, nearshore, and reference stations. For these five years, LEC values ranged between 0.02 and 0.08 k. Therefore, LEC values in all five years were below the Hawaii water quality standard at all monitoring stations.

Projected Discharge

The concentration of suspended solids at the completion of initial dilution is calculated using Equation B-31 from the ATSD:

$$SS_f = SS_a + (SS_e - SS_a)/SS_a$$

where:

SS_f	=	Suspended solids concentration at completion of initial dilution, mg/L
SS_a	=	Affected ambient suspended solids concentration immediately upcurrent of the diffuser averaged from the diffuser port to the trapping level, mg/L
SS_e	=	Effluent suspended solids concentration, mg/L
S_a	=	Initial dilution

The applicant obtained a worst-case increase in suspended solids of 0.45 mg/L by using an ambient measurement of 0.5 mg/L, an effluent suspended solids concentration limit of 95 mg/L, and a minimum initial dilution of 210. The applicant calculated SS_f to be 0.95 mg/L.

EPA recalculated the worst-case increase using the revised initial dilution of 118 with an SS_a of 0.5 mg/L and an SS_e of 95 mg/L. EPA obtained a worst-case increase in suspended solids of 0.80 mg/L and, consequently, calculated SS_f to be 1.30 mg/L.

The ATSD indicates than an increase in suspended solids at the completion of initial dilution of less than 10 percent is not likely to present a substantial effect in the water column. However, the ATSD notes that seabed deposition could still be substantial, depending on the mass emission rate of suspended solids and ambient currents at the discharge site, and should be evaluated. Both the applicant and EPA calculated worst-case increases in suspended solids greater than 10 percent because a very low ambient concentration was applied in Equation B-31. EPA reviewed seabed deposition data provided by the applicant and found no accumulation of solids (see section 3.d. in this document).

EPA concludes that receiving water for the Honouliuli outfall meets the Hawaii water quality standards for turbidity and LEC in Class A “wet” open coastal waters.

Turbidity Conclusion

Overall, the applicant has demonstrated the ability to meet the Hawaii water quality standards for DO, turbidity, and LEC. Our review of the receiving water monitoring data indicates that the outfall does not have a significant effect on the receiving waters for these parameters.

C. Attainment of Other Water Quality Standards and Impact of Discharge on Public Water Supplies; Shellfish, Fish and Wildlife; and Recreation

Section 301(h) generally contemplates that, in order to qualify for a variance, a discharge must protect human health and the environment. Specifically, section 301(h)(2) requires that the applicant's discharge must maintain water quality which assures protection of public water supplies; assures protection and propagation of a balanced indigenous population of shellfish, fish and wildlife; and allows recreational activities. In addition, section 301(h)(9) requires that the applicant must be discharging effluent which meets the criteria established under section 304(a)(1) after initial dilution. This portion of the TDD addresses these requirements as specified in EPA regulations, most specifically in 40 CFR 125.62.

1. Attainment of Other Water Quality Standards and Criteria

40 CFR 125.62(a) requires that the applicant's outfall and diffuser be located and designed to provide adequate initial dilution, dispersion, and transport of wastewater such that the discharge does not exceed, at and beyond the ZID, all applicable water quality standards and, for pollutants for which there are no EPA-approved standards, section 304(a) criteria. Additionally, 40 CFR 125.59(b)(1) prohibits issuance of a modified permit that would not assure compliance with all applicable requirements of Part 122, one of which is that a permit must ensure compliance with all water quality standards [40 CFR 122.4(d) and 122.44(d)]. For purposes of this review, the applicable water quality standards are analyzed in five categories: bacteria, toxics, whole effluent toxicity, nutrients, and pH. The ability of the proposed discharge to attain water quality standards for DO and turbidity was assessed in section B of this TDD.

a. Bacteria

Water quality criteria for bacterial indicators protect human health by limiting pathogens in waters designated for recreational uses, thereby reducing the risk of illness resulting from exposure to pathogenic organisms in recreational waters. Enterococcus is the bacterial indicator applied to marine waters.

Present water quality standards applicable to Hawaii's marine waters are the following:

1) Hawaii Administrative Rules (HAR) – as amended October 2004:
Within 300 meters (1000 feet) of the shoreline, HAR Chapter 11-54-8 applies specific criteria for marine recreational waters:

- Enterococci bacteria content shall not exceed a geometric mean of seven colony-forming units (cfu) per 100 milliliters (ml) in not less than five samples spaced to cover a period between 25 and 30 days.

- No single sample shall exceed the single sample maximum of 100 cfu per 100 ml.
- At locations where sampling is less frequent than five samples per 25 to 30 days, no single sample shall exceed the single sample maximum nor shall the geometric mean of these samples taken during the 30-day period exceed seven cfu per 100 ml.

2) In response to the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, EPA promulgated bacteria criteria for coastal recreational waters on November 16, 2004, based on EPA's *Ambient Water Quality Criteria for Bacteria* (1986). These criteria became effective on December 16, 2004 and applied to Hawaii's marine waters not previously protected by State criteria. Therefore, 40 CFR Section 131.41(c)(2) applies the following criteria to Hawaii's marine waters between 300 meters (1000 feet) from shore and three miles from shore:

- Enterococci bacteria content shall not exceed a geometric mean of 35 cfu per 100 ml
- No single sample shall exceed the single sample maximum of 501 cfu per 100 ml. [In 40 CFR Section 131.41(c)(2)(C), EPA promulgated a range of four single sample maximum values between 104 and 501 cfu per 100ml. EPA's rule expects States to apply the appropriate single sample maximum value based on use of coastal recreation waters. HDOH informed EPA that the single sample value of 501 cfu per 100 ml is appropriate for waters beyond 300 m (1,000 ft) from shore due to infrequent recreational use in these waters (Lau, 6 September 2005 letter). However, HDOH has not yet amended HAR Chapter 11-54 to formally adopt a single sample value applicable to these waters. Additionally, HDOH issued an NPDES permit for the Kailua Regional Wastewater Treatment Plant (Permit No. HI0021296) on August 3, 2006 and applied a single sample maximum value of 104 cfu per 100 ml as a permit limitation in waters beyond 300 m (1,000 ft) from shore. Consequently, this review assesses both single sample maximum values.]

3) In the Federal Register (Vol.69, No.220) notice accompanying the final rule for water quality criteria for bacteria in coastal waters, EPA responded to a comment on the proposed rule suggesting that criteria should only apply at depths less than 150 feet (46 m). EPA did not find the comment persuasive in light of the clear language of Clean Water Act sections 303(i) and 502(21), which required adoption of criteria for all of the coastal or Great Lake waters designated by the State for use for swimming, bathing, surfing, or similar water contact activities even if the waters designated for swimming are not frequently or typically used for swimming. The HWWTP discharges to Class A open coastal waters. HAR Chapter 11-54-3 (Classification of water uses) states:

> It is the objective of class A waters that their use for recreational and aesthetic enjoyment be protected. Any other use shall be permitted as long as it is comparable with the protection and propagation of fish, shellfish, wildlife, and with recreation in and on these waters. These waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with the criteria established for this class.

The existing permit requires the applicant to conduct the following water quality monitoring:

Shoreline - Sample enterococci densities at four shoreline stations (HS1, HS2, HS3, and HS4) five days a month at surface.

Nearshore - Sample enterococci densities at four nearshore stations (HN1, HN2, HN3, and HN4), located approximately 610 meters (2000 feet) or less from shore, five days a month at surface and bottom of water column. Due to dynamic surf conditions close to shore, the applicant indicates nearshore stations were located 500 to 1000 meters (1640 to 3281 feet) from shore, at a depth of approximately 11 meters (36 ft).

Offshore - Sample enterococci densities on a quarterly basis at the edge of the zone of initial dilution (stations HB2, HB3, HB4, and HB5), at the edge of the zone of mixing (stations HM1, HM2, HM3, and HM4), southwest of the zone of mixing boundary (station HB6), and at two reference stations (HB1 and HB7). Sampling is required at the surface and bottom depths of each site.

In EPA's review, attainment of HAR Chapter 11-54-8 recreational standards was assessed at the four shoreline locations and attainment of EPA's promulgated criteria was assessed at the four nearshore and nine offshore stations (Figure 3).

Data Analyses

The applicant summarized geometric means of enterococci densities at eight shoreline and nearshore stations for the period of January 1989 through May 2004 in Appendix G of the application. The applicant also provided EPA with a database of shoreline, nearshore, and offshore monitoring results for the period from June 1991 through December 2006. EPA reviewed all of these data in addition to the applicant's receiving water monitoring annual reports for the period from January 1998 through December 2005. In this review, monitoring data are compared to the appropriate geometric mean and single sample maximum value. Both parts of the criteria are applicable to Hawaii's marine waters and both must be used to determine whether Hawaii's water quality criteria are met and uses protected.

The single sample maximum value allows a single data point to be evaluated. It is a tool for making beach notification and closure decisions and is an appropriate tool for determining whether water quality on a particular day is protective of the designated use.

A geometric mean represents the central tendency of a series of data points. The best way to interpret a series of bacterial measurements taken over a period of time is in comparison to the geometric mean. HAR Chapter 11-54-8 states that the geometric mean applies to samples taken in a twenty-five to thirty day period but does not dictate a monthly period versus a rolling or running period. EPA did not specify in the final promulgated rule for bacteria criteria how the averaging period for the geometric mean must be applied. The preamble to the rule (Federal Register Vol. 69, No. 220) recommends that the averaging period be applied as a rolling or running average. EPA expected most States would apply the averaging period as a rolling average; however, EPA also recognized that it would be technically appropriate to apply the averaging period on a set basis such as monthly. For ease in this review, geometric means were developed based on a monthly period. For shoreline and nearshore water, monthly geometric mean averages were generally based on five to six samples. For offshore water, where sampling was conducted monthly from November 2003 through November 2004 but otherwise conducted on a quarterly basis, the geometric mean criterion was compared against the one monthly, or quarterly, monitoring result. Lack of data does not preclude assessment against the geometric mean value in an analysis for 301(h) variances. HAR Chapter 11-54 requires data to be assessed against the geometric mean criterion, even if sampling is less frequent than five samples per 30-day period.

Shoreline

More than 3,300 samples were collected at the four shoreline monitoring sites between 1991 and 2006. Throughout this period, there were six exceedances of the geometric mean criterion (7 cfu/100 ml) at the four shoreline stations. All geometric mean exceedances occurred at either HS1 or HS2. Concentrations ranged between 8 and 10 cfu/100 ml on five occasions at stations HS1 and HS2 in 1991, 1992, and 2004. These five values are slightly above the State criterion. The sixth shoreline exceedance during this 15-year period occurred in 1996 at site HS1. A geometric mean of 17 was calculated based on the five shoreline sample results from site HS1 during November 1996. Additional sampling at Iroquois Beach, which is not a monitoring site established by the permit but rather a site developed by the permittee to track urban runoff, also indicated high bacterial counts during November 1996. Samples collected at HB1 during November 1996 could have been influenced by runoff rather than effluent from the outfall.

In August 2004, the Hawaii Department of Health amended HAR Chapter 11-54-8 to adopt a single sample maximum value of 100 cfu/100 ml for enterococci concentrations in marine waters within 300 meters (1000 feet) from shore. The new State criterion became effective in October 2004. During 2005, one sample exceeded 100 cfu/100 ml. Shoreline monitoring in April 2005 revealed one sample with a bacterial density of 300 cfu/100 ml at site HS2. On the same sample date, similar exceedances were not detected

in any of the surrounding monitoring or reference sites. There were no exceedances of this criterion in 2006.

The new single sample criterion was applied to monitoring data collected between 1991 and 2004 in order to determine whether present criteria would have been met by past treatment methods. Between 1991 and 2004, nine of the 2,861 shoreline samples exceeded the single sample maximum value. Exceedances occurred at sites HS1 and HS2. Single sample values at these sites ranged between 156 and 1,500 cfu/100 ml.

Throughout the 1991 to 2006 period, there were many criteria exceedances at the additional reference stations (Hammer Point and Iroquois) voluntarily monitored by the permittee. However, these stations are influenced by non-point sources of bacterial contamination and do not necessarily indicate influence from the discharge point.

Given the limited number of water quality exceedances at shoreline monitoring sites compared to the large number of shoreline sample events and the possibility that other sources may have been responsible for the observed exceedances, EPA concludes that shoreline stations do not appear to be exceeding water quality standards due to influence from the discharge.

Nearshore

Prior to EPA's promulgation of bacteria criteria, the State of Hawaii had not applied bacteria criteria to waters beyond 300 meters (1000 feet) from shore. Hawaii's water quality standards only contained a trigger to resample when enterococci counts exceeded 70 cfu per 100 ml. As of December 2004, EPA's promulgated criteria apply to these waters.

The applicant collected approximately 7,000 samples from the four nearshore monitoring sites between 1991 and 2006. Nearshore stations were monitored at the surface and at a depth of 11 meters (36 feet). There were no exceedances of EPA's promulgated criteria (either geometric mean of 35 cfu per 100 ml or single sample maximum) in the 488 surface and bottom samples taken in 2005, after EPA's criteria were effective. Likewise, there were no criteria exceedances in the 496 samples assessed in 2006.

Monitoring data collected between 1991 and 2004 were also assessed, retroactively, against the promulgated criteria in order to determine whether past monitoring results would meet current criteria. There were no exceedances of the geometric mean criterion of 35 cfu per 100 ml at nearshore surface or bottom stations during the 1991 to 2004 reporting period. Three of the 6,184 nearshore samples exceeded the single sample maximum of 501 cfu per 100 ml. In June 1994, one sample from the surface of station HN3 revealed a concentration of 2,800 cfu per 100 ml. In January 2004, one bottom sample at station HN3 contained an enterococci concentration of 800 cfu per 100 ml and one HN2 bottom sample taken in February 2004 contained a concentration of 570 cfu per 100 ml. These few exceedances of the single sample criterion suggest that the plume may occasionally hit the nearshore waters

If the single sample maximum limit were set at 104 cfu per 100 ml rather than 501 cfu per 100 ml, one of the 244 nearshore bottom samples taken in 2005 and 7 of the 248 bottom samples taken in 2006 would have exceeded the more protective single sample value. Likewise, 57 of 6,216 samples taken between 1991 and 2004 would have exceeded the lower single value limit (Table 8). Of these 57 exceedances, 23 occurred in the surface and 34 occurred in the bottom samples. Consequently, nearshore monitoring stations meet the geometric mean criterion but do not always meet the single sample maximum limit set at the more protective value of 104 cfu per 100 ml. When compared to this lower single sample maximum limit, the data indicate that the effluent plume may occasionally affect surface samples as well as bottom samples taken at 11 meters (36 feet), a depth likely to be encountered by recreational divers.

Offshore

Offshore Data from 2005 and 2006

The permittee submitted monitoring data from 11 offshore stations. Four stations were located on the boundary of the ZID, four stations were located on the boundary of the ZOM, one station (HB6) was located beyond the ZOM, and two reference stations were located downcoast and upcoast of the discharge.

EPA reviewed the data to determine if the plume exceeded applicable criteria at the edge of the ZID. EPA would not expect the plume necessarily to impact all ZID stations at the same time, as ocean currents may push the plume in a specific direction. Therefore, EPA reviewed this data to determine if any of the ZID, ZOM, or the near-ZOM stations were affected at a given time. If all the ZID, ZOM, and the near-ZOM stations exceeded criteria at the same time, EPA evaluated the data from the reference stations to determine if another source of contamination could be causing the exceedances.

Offshore monitoring conducted by the permittee on a quarterly basis in 2005, after EPA's promulgated criteria became effective, produced data from four monitoring events conducted in February, April, August, and November. The same monitoring was conducted in 2006 in the months of March, May, July, and October. The nine offshore sites were sampled four times in each year at the surface and bottom depths. Bottom depths ranged from 41 to 70 meters (134 to 230 feet). Two reference stations (HB1 and HB7) were also monitored at the surface and bottom depths on a quarterly basis. Thus, a total of thirty-six samples were taken each year at each depth, excluding samples collected at the reference stations.

EPA's criteria were applied to sample results at each site and depth individually. The geometric mean was exceeded once in the 36 surface samples taken in 2005 (Table 9). The exceedance occurred in the surface sample at site HB5 in August 2005. Nineteen (53%) of the 36 samples from bottom depths exceeded the geometric mean criterion. Of the 19 total exceedances at the bottom depths, ten occurred at sites surrounding the ZID (HB2, HB3, HB4, and HB5), six occurred at sites surrounding the ZOM (HM1, HM2,

and HM4), and three occurred beyond the ZOM at site HB6. At the ZID, site HB2 exceeded the criterion in only one month while sites HB3, HB4, HB5, and HB6 exceeded the criterion in three of the four months sampled during 2005. At the ZOM, site HM1 exceeded the geometric mean in two months, site HM2 exceeded in one month, and site HM4 exceeded the criterion in three of the four months monitored. In addition to these 19 exceedances, there was one exceedance of the geometric mean at reference site HB1 in the April sample of the bottom depth.

In 2006, there were four exceedances in the 36 surface samples. The exceedances occurred at sites HB3 and HM3. Thirty (83%) of the 36 bottom samples exceeded the geometric mean criterion. Of the 30 exceedances at the bottom depths, 15 occurred at sites surrounding the ZID (HB2, HB3, HB4, and HB5), 11 occurred at sites surrounding the ZOM (HM1, HM2, HM3, and HM4), and the geometric mean criterion was exceeded in all four bottom samples taken at site HB6. At the ZID, site HB2 and HB3 exceeded the criterion in three of the four months while sites HB4, HB5, and HB6 exceeded the criterion in all four months sampled during 2006. At the ZOM, sites HM1 and HM2 exceeded the geometric mean in three of the months monitored, site HM3 exceeded in one month, and site HM4 exceeded the criterion in all four months monitored.

Exceedances of the geometric mean at the ZID and ZOM stations resulted even when an annual average was developed for each sampling location based on quarterly monitoring data from 2005 and 2006. When offshore monitoring data from February, April, August, and November of 2005 were combined to form a long-term geometric mean, bottom samples from sites HB3, HB4, HB5, HB6, HM1, and HM4 still exceeded the criterion. Geometric mean values at these sites ranged between 43 and 188 cfu/100 when an annual average was calculated. When offshore monitoring data from March, May, July, and October of 2006 were combined to form a long-term geometric mean for each station, bottom samples from all four ZID stations, all four ZOM stations, and HB6 exceeded the criterion. Geometric means calculated on an annual basis ranged between 74 and 727 for bottom samples. Although this averaging method does not conform to Hawaii's water quality standards, it does support the findings generated on a monthly basis.

The permittee's application suggests that monitoring data from all ZID and ZOM stations should be combined to determine a geometric mean for the entire region around the ZID. EPA does not believe this method of analysis is protective of recreational waters because, at any given time, the effluent plume tends to move in a single direction. Averaging data points affected by the plume with data from the unaffected side of the monitoring grid would not ensure protection of swimmers in all locations. Furthermore, Section 301(h) regulations require water quality standards to be met at the edge of the ZID. Therefore, the proper evaluation is whether the plume exceeds standards when and where it leaves the ZID.

There have also been suggestions that surface and bottom samples should be combined to form one geometric mean to represent the entire water column at each site. This method is not advisable for determining whether water quality standards are met in receiving water because the plume may not impact both the surface and depth at the same time.

However, if this calculation method had been applied, there would have still been six (16%) exceedances of the geometric mean during the four offshore sample events in 2005 (Table 9). Using this method, water column geometric mean exceedances occurred at ZID stations HB4 and HB5 and ZOM stations HM1 and HM4. There would have been 11 (31%) exceedances of the geometric mean during the four monitoring events in 2006. The water column geometric mean exceedances occurred at ZID stations HB2, HB3, HB4, and HB5 and ZOM stations HM1, HM2, HM3, and HM4.

During 2005, the single sample maximum value of 501 cfu/100 ml was not exceeded in any surface samples but was exceeded in eight bottom samples (Table 10). The exceedances ranged between 540 and 2600 cfu/100 ml at two sites around the ZID (HB3 and HB5), two sites around the ZOM (HM1 and HM4), and beyond the ZOM (HB6). The sample containing the highest single value was collected at the bottom of site HM1. This site is located on the shoreline side of the zone of mixing, indicating that the effluent plume moved toward the shore on that occasion.

If the single sample maximum value were set at 104 cfu/100 ml for offshore water, there were 13 exceedances in 2005 (Table 11). One of the 13 exceedances was at the surface of site HB5, and the remaining 12 exceedances were in bottom samples at ZID sites (HB3, HB4, and HB5), ZOM sites (HM1 and HM4), and beyond the ZOM (HB6). There was one exceedance at reference site HB1.

During 2006, the single sample maximum value of 501 cfu/100 ml was not exceeded in any surface samples but was exceeded in nine bottom samples (Table 10). The exceedances ranged between 510 and 2200 cfu/100 ml at four sites around the ZID (HB2, HB3, HB4, and HB5) and one site around the ZOM (HM1).

If the single sample maximum value were set at 104 cfu/100 ml for offshore water, there would have been 19 exceedances in 2006 (Table 11). One of the 19 exceedances was at the surface of site HM3, and the remaining 18 exceedances were in bottom samples at ZID sites (HB2, HB3, HB4, and HB5), ZOM sites (HM1, HM2, and HM4), and beyond the ZOM (HB6).

A statement in the application claims that decisions should not be made based on single samples. However, the single sample value describes the water quality actually encountered by swimmers and divers on the day the sample was collected. It is a useful tool in determining swimmer and diver risk. When this portion of the water quality criteria is not met, swimmers and divers have a greater risk of illness and, therefore, recreational uses are not protected.

Water quality criteria were consistently exceeded in 2005 and 2006 due to the discharge. During the eight sampling events in 2005 and 2006, the geometric mean or the single sample maximum criteria were exceeded in seven of the eight monitoring events in at least one ZID or ZOM location. February 2005 was the only month when then were no exceedances of either criterion. The criteria were never exceeded at all nine monitoring stations at the same time, so the observed exceedances are likely due to the effluent

plume. Therefore, EPA concludes that the plume consistently caused exceedances of water quality criteria for pathogens in 2005 and 2006.

Offshore Data Prior to 2005

Prior to EPA's promulgation, the State of Hawaii did not apply bacteria criteria to waters beyond 300 m from shore. In this review, we retroactively applied the promulgated criteria to data collected from offshore waters during the period between 1991 and 2004 to determine whether past treatment practices and monitoring results would have met current criteria. Due to different monitoring frequencies and depths, data from this period are reviewed in two parts: 1) November 2003 to November 2004, and 2) June 1991 to October 2003.

Offshore Data from November 2003 to November 2004

Between November 2003 and November 2004, the applicant conducted monthly, rather than quarterly, monitoring at three depths (surface, middle, and bottom) in the water column at the nine offshore sample sites. There were 13 monitoring events during this period, which generated 117 data points at each depth of the nine monitoring stations around the ZID and ZOM. Two reference stations were also monitored at all three depths. A mid-depth sample location, between 20 and 35 meters (66-115 feet) deep, was added to the monitoring sites established by the permit in order to gain more information about how the effluent plume disperses between the surface and bottom of the water column.

During this 13-month period, seven (6%) of the 117 surface samples, 42 (36%) of the 117 mid-depth samples, and 71 (61%) of the 117 bottom samples exceeded the geometric mean criterion (Table 12). This information in and of itself demonstrates that the water quality criteria were exceeded as a result of the discharge. Additionally, when a geometric mean was developed using data from all three depths at each individual site, the geometric mean criterion was still exceeded on 27 (23%) of 117 occasions at nine stations (HB2, HB3, HB4, HB5, HB6, HM1, HM2, HM3, or HM4). Eight of the 27 exceedances occurred at site HM1 and five occurred at site HB4. Sites HB5 and HB6 each exceeded the criteria on three occasions, and sites HB2, HB3, HM2, and HM4 each exceeded the criteria on one occasion. Although the practice of developing a geometric mean based on data from the entire column is not advisable as a method of determining whether criteria are met and recreational uses are protected, it was done in this review only to demonstrate the extent of exceedances that resulted even when data from the entire water column were combined. During this period, there were two exceedances of the geometric mean at reference station HB1. The exceedances occurred at the top of the water column in the November 2004 sample and at the bottom of the water column in the November 2003 sample.

Exceedances of the geometric mean at the ZID and ZOM stations resulted even when 13 months of data from each site were used to develop a long-term average. In the 13-month period, samples from the mid-depth at site HM1 and samples from the bottom of

the water column at sites HB4, HB5, HB6, HM1, and HM4 exceeded the geometric mean criterion. Long-term geometric mean averages at these ZID sites ranged between 46 and 258 cfu/100 ml. As stated earlier, this averaging method does not conform to Hawaii's water quality standards, but it does support the findings generated on a monthly basis.

Another way to view the extent of the geometric mean exceedances across the entire monitoring grid is to determine the number of stations when the criterion was not met during one month. During three of the 13 monitoring months between November 2003 and November 2004, the geometric mean was exceeded in at least one station in the surface samples (Table 12). Between one and eight of the nine mid-depth stations exceeded the geometric mean in 12 of the 13 months. For example, one (HM1) of the nine mid-depth stations exceeded the geometric mean in May while eight sites exceeded the geometric mean in January (HB2, HB3, HB4, HB5, HB6, HM1, HM2, and HM4). Between two and nine of the nine bottom stations exceeded the geometric mean each month during the 13-month monitoring period. All told, in all of the 13 months, one or more of the ZID-boundary, ZOM-boundary, or near-ZOM samples exceeded the geometric mean. At no time did all of the samples exceed the geometric mean, so another source of the exceedance is unlikely.

The single sample maximum value of 501 cfu/100 ml was exceeded once at the surface, on two occasions in the mid-depth samples and in 18 bottom samples during the 13-month period (Table 13). Exceedances of the criteria at mid-depth show that water quality standards are not met in the top 100 feet of the water column, where the applicant believes most recreational uses occur.

If the single sample maximum value is set at 104 cfu/100 ml, the criterion would have been exceeded 5 (4%) of 117 times at the surface, 21 (18%) of 117 times at the mid-depth, and 37 (32%) of 117 times in the bottom samples (Table 14).

Offshore Data from June 1991 to October 2003

When the current criteria are applied to monitoring data collected between 1991 and 2003, the geometric mean of 35 cfu/100 ml was exceeded in 55 (12 %) of the 441 surface samples and 261 (59 %) of the 441 bottom samples taken at depths between 57 and 70 meters (187 and 230 feet). If a geometric mean was developed by combining surface and bottom sample results at each individual site, there would have been 74 exceedances of the present criteria (Table 15).

The current single sample maximum value of 501 cfu/100 ml was also applied retroactively to past monitoring results. There were 441 samples taken at each depth during this period. Four (1 %) exceedances at the surface and 45 (10%) exceedances at the bottom depths would have resulted between 1991 and 2003 (Table 16). Single sample values above 501 cfu/100 ml ranged up to 1000 cfu/100 ml in the surface samples and up to 3600 cfu/100 ml in the bottom samples.

If the single sample maximum value is set at 104 cfu/100 ml rather than 501 cfu/100 ml, there would have been 43 exceedances on the surface and 156 exceedances in the bottom depths throughout the 1991- 2003 time span (Table 17).

As described earlier, the proposed level of treatment is less than the treatment level currently achieved. The applicant provided no indication that treatment practices will improve in the future. If the Honouliuli treatment plant continues to operate in the future as it has in the past, we would expect to continue seeing a large number of bacteria criteria exceedances in offshore recreational waters. Likewise, if wastewater flow increases during the next permit period, as anticipated in the application, even more exceedances of bacteria criteria would be expected. The result will be more days when water quality standards are not met and even less protection of recreational uses.

Fecal coliform

Fecal coliform densities were also collected at the monitoring stations. A State standard for fecal coliform no longer exists for Hawaii's marine waters and was replaced with the enterococci criteria. Therefore, fecal coliform data were not considered in this review.

Conclusion

EPA concludes that bacterial concentrations associated with the discharge of wastewater from the Honouliuli outfall do not meet current water quality standards. This conclusion is based on EPA's review of receiving water monitoring data relative to HAR Chapter 11-54 and EPA's promulgated criteria for bacteria in coastal waters.

Although water quality criteria are generally met at the shoreline monitoring stations, discharge from the Honouliuli wastewater treatment plant does not meet water quality criteria at the edge of the zone of initial dilution, at the edge at the zone of mixing, or at the one monitoring station beyond the zone of mixing. Exceedances of the geometric mean criteria occurred even when surface and bottom samples were averaged. Furthermore, when sampling was increased from a quarterly to a monthly basis, there was an increase in the percentage of days when water quality criteria were not met. These results support comments submitted by the applicant (Doyle, 12 August 2004 letter) in response to EPA's July 9, 2004 notice of proposed rule making for bacteria in coastal recreation waters (Federal Register Vol. 69, No. 131). In their comments, the applicant indicated that primary treated wastewater from the Honouliuli wastewater treatment plant would not meet EPA's criteria at the point of discharge unless the plant was upgraded to secondary treatment to allow effective disinfection.

If the modified permit were renewed, components of discharged effluent would vary during the next permit period as the applicant increased reuse of treated effluent, as is contemplated by the 1995 Consent Decree. As reuse of treated wastewater increased, the final effluent would likely be more concentrated and could result in more exceedances of bacteria criteria and less protection of recreational uses. It is difficult to judge the extent of future exceedances based on past monitoring results, but the proposed discharge would

likely continue to exceed applicable criteria. Therefore, EPA has concluded that the applicant has failed to show it can consistently achieve water quality standards or water quality criteria for bacteria beyond the ZID. Additionally, the failure to achieve bacteria standards adversely affects recreational uses in offshore waters, as is discussed in section C.4.b. below.

b. Toxics

In accordance with 40 CFR 125.66, which implements CWA section 301(h)(7), the applicant is required to provide a chemical analysis of its effluent under both wet and dry weather conditions for the priority toxic pollutants and pesticides defined in 40 CFR 125.58(p) and (aa). The present discharge permit requires the applicant to conduct an annual priority toxic pollutant and pesticide scan on 24-hour composite samples of the wastewater treatment plant's influent and effluent. Annual sampling must alternate between wet (January/February) and dry (July/August) seasons. The permit also requires annual (January/February) testing for asbestos.

The application contains a review of priority toxic pollutant and pesticide monitoring data from 1991 through 2003. The applicant also submitted AARs, as required by the NPDES permit. Each AAR contains a "Summary of Detected Priority Pollutants, 301(h) Pesticides and Additional Water Quality Analytes" which addresses samples from the influent, primary clarifier, and final effluent. Final effluent results are also recorded on the applicant's monthly DMRs, as required by the NPDES permit.

The applicant assessed priority toxic pollutant and pesticide data generated by effluent monitoring conducted from July 1991 through December 2003. In Appendix J of the August 2004 application, State water quality standards and Federal water quality criteria were compared to the final effluent concentration after applying a critical initial dilution value of 228:1. However, as discussed earlier under "Initial Dilution" in this review, the applicant computed a critical initial dilution of 210:1 for the Honouliuli discharge and described this computation in Appendix F of the application. Appendix F and Appendix J of the application present two different calculations of initial dilution. Instead of applying the critical initial dilution of 210:1, the applicant actually applied a critical initial dilution value of 228:1 to the concentrations of priority toxic pollutants and pesticides in the final effluent before comparing them the State water quality standards and Federal water quality criteria. In the August 2004 application, the applicant computed the initial dilution value of 228:1 using the DOS Plumes model, the March 2000 maximum peak hourly estimated flow rate flow rate of 2.242 m^3/sec (51.17 MGD), current speeds of either 2.4 or 5.4 cm/sec depending on depth in the profile, and the January 10, 1994 temperature and salinity depth profile from station HZ. However, in Appendix J, the applicant explained that the 1995 application for the 301(h) variance, which is a previous version of the 2004 application, applied a critical initial dilution of 228:1. The applicant stated that the method used to determine the minimum dilution value had not changed since the 1995 application. Therefore, the applicant reasoned that the critical initial dilution value of 228:1 still applies to the assessment of State water quality standards and Federal water quality criteria. In this manner, the applicant

concluded there were no exceedances of State water quality standards or Federal water quality criteria during the period from July 1991 through December 2003. As explained earlier under "Initial Dilution" in this review, EPA's recalculated critical initial dilution value is 118:1 and the average dilution value is 412:1. These are the values applied by EPA to State water quality standards and Federal water quality criteria for the discharges from this facility.

As described more fully in section C.1.c. of this review, an effluent flow meter was not present from July 2000 until December 1, 2003. The applicant indicates that reported priority toxic pollutant and pesticide concentrations prior to December 1, 2003 were approximate values due to the lack of accurate flow readings necessary to collect accurate flow weighted 24-hour composite samples. During this period, the applicant based effluent estimates on influent flow rates. Continuous flow monitoring of influent and effluent is required by the permit. Without accurate effluent flow rate data, it is not possible to produce an accurate flow-weighted 24-hour composite effluent sample for further analysis of effluent quality. During the period from July 2000 until December 1, 2003, the applicant did not provide accurate and certified priority toxic pollutant results on DMRs to EPA, as required by the permit. Instead, the approximate priority toxic pollutant and pesticide concentrations were reported separately.

The applicant failed to indicate whether the effluent flow meter was present or functional prior to July 2000. Consequently, EPA focused its review on those priority toxic pollutant and pesticide scans collected after the effluent flow meter was installed on December 1, 2003. Since the installation of the effluent flow meter, three priority toxic pollutant and pesticide scans were collected on December 3, 2003; August 17, 2004; and January 19, 2005. The applicant considers the August sample to have been indicative of dry-weather conditions and the December and January samples to be indicative of wet-weather conditions. In these three samples, the applicant detected 12 metals, 10 organics, and three 301(h) pesticides. Asbestos was not detected in any of the three samples. The maximum reported values of priority toxic pollutants and pesticides for which State water quality standards and Federal water quality criteria are published are summarized in Table 18 of this document.

Numeric water quality standards for toxic pollutants listed in HAR 11-54-4(b)(3) provide acute and chronic criteria to protect aquatic life and criteria to protect human health from exposure to pollutants through fish consumption. This list also identifies toxic pollutants categorized as carcinogens. In accordance with HAR 11-54-4(b)(3) and the HDOH *State Toxics Control Program: Derivation of Water Quality-Based Discharge Toxicity Limits for Biomonitoring and Specific Pollutants* (1989), the minimum dilution is used when comparing toxic pollutant and pesticide concentrations to chronic criteria for aquatic life and non-carcinogen fish consumption criteria for human health. The average dilution value is used when comparing toxic pollutant and pesticide concentrations to human-health fish consumption criteria for carcinogens.

After the critical (i.e., minimum) initial dilution value of 118:1 computed by EPA is applied to the detected effluent concentrations, all priority toxic pollutant and pesticide

values from the three samples were below applicable chronic criteria and non-carcinogen fish consumption criteria for human health.

After the average dilution value of 412:1 computed by EPA is applied to the detected effluent concentrations, concentrations of two pesticides, chlordane and dieldrin, exceeded the State carcinogen fish consumption criteria for human health. Concentrations of chlordane exceeded the fish consumption criterion in two of the three pesticide scans and concentrations of dieldrin exceeded the fish consumption criterion in all three scans.

The chlordane concentration detected in the January 2005 sample is 0.071 ug/l. This result is below the minimum level (ML) of 0.10 ug/l but above the method detection level (MDL) of 0.059 ug/l. The ML is the level at which the entire analytical system gives a recognizable reading and acceptable calibration points. The MDL is the minimum concentration of a substance that can be measured and reported with 99-percent confidence. Quantitation in the range between the MDL and the ML is not as precise or accurate as it is in the range above the ML. Chlordane was not detected in the August 2004 sample, which is the sample representing the dry season. The chlordane concentration measured in the December 2003 sample is 0.10 ug/l. This value is at the ML and above the MDL. When the long-term effective dilution value of 412:1 is applied to the two sample results where chlordane is detected, the concentration of chlordane in the receiving water at the ZID is calculated to be 0.00017 and 0.00024 ug/l. The water quality criterion for chlordane, to protect human consumption of fish, is 0.00016 ug/l. Thus, the water quality criterion was exceeded in both of the samples where chlordane was detected.

Dieldrin concentrations in the three samples were 0.013, 0.035, and 0.055 ug/l. All three reported values are above the ML of 0.009 ug/l. After the average dilution value of 412:1 is applied to the sample results, dieldrin concentration in the receiving water at the ZID is calculated to be 0.000032, 0.000085 and 0.00013 ug/l. The water quality criterion for dieldrin, protective of human consumption of fish, is 0.000025 ug/l. Thus, all three samples exceed the water quality criterion for dieldrin.

Although chemical analysis of composite samples analyzed before the effluent flow meter was installed on December 1, 2003 only represent an estimate of pollutant concentrations, EPA reviewed these sample results as supporting evidence. EPA's review of these estimated results indicates that the chlordane fish consumption criterion was exceeded in February 2001 and July 2002, and the dieldrin fish consumption criterion was exceeded in the three samples taken in February 2001, July 2002, and January 2003.

As discussed earlier, the applicant indicates that the application is based on an "altered discharge" of various combinations of primary, secondary, and tertiary treated effluent, brine from reverse osmosis treatment, and tertiary treatment filter backwash. Starting in September 1996, the applicant began mixing secondary treated wastewater with the primary treated wastewater for discharge through the ocean outfall. Since September

2000, the applicant has added varying amounts of tertiary treated wastewater to the final discharged effluent. The application does not indicate the amount of secondary and tertiary treated wastewater that will be mixed with the primary treated effluent during the next five-year permit term. Furthermore, it is not known whether the supply of this more highly treated wastewater will be available for diluting the primary treated effluent when reuse of treated wastewater increases in future years. On December 14, 2004, EPA informed CCH of the areas where the application was deficient and additional data were needed (Hashimoto, 14 December 2004 letter). In response to this letter, the applicant submitted additional information to EPA on April 15, 2005, as discussed above under "Description of Treatment System – Altered Discharge." The response described six possible discharge scenarios for the Honouliuli WWTP. In one scenario, the discharge would be composed entirely of primary effluent. In another scenario, the discharge would contain primary treated effluent, along with minimal amounts of secondary and tertiary treated effluent, brine from reverse osmosis, and tertiary filter backwash. Under both scenarios, the quality of the proposed effluent discharge is worse than effluent discharged during the term of the existing permit and, thus, could result in additional exceedances of water quality standards for chlordane, dieldrin, and other pollutants.

Conclusion

The Honouliuli discharge contains concentrations of chlordane and dieldrin that exceed water quality standards. These standards were established to protect human health from ingestion of carcinogens through fish consumption. Based on three 24-hour composite samples, the discharge meets all other water quality standards for toxic pollutants and pesticides. The proposed discharge is of a lower quality than the current discharge. Therefore, EPA concludes that the proposed discharge, at a minimum, will not comply with water quality standards for chlordane and dieldrin.

c. Whole Effluent Toxicity

In 1989, EPA defined whole effluent toxicity (WET) as "the aggregate toxic effect of an effluent measured directly by a toxicity test" (54 FR 23868 at 23895, June 2, 1989). Aquatic toxicity tests are laboratory tests that measure the biological effect (e.g., acute effect such as mortality and chronic effects such as growth and reproduction) of effluents or receiving waters on aquatic organisms. In aquatic toxicity tests, organisms of a particular species are held in test chambers and exposed to different concentrations of an aqueous sample (e.g., effluent, effluent combined with dilution water, or receiving water). Observations are then made and recorded at predetermined exposure periods and at the end of the test. The measured responses of the test organisms are used to evaluate the effects of the aqueous test sample. In the NPDES program, WET test results are used to evaluate both the toxicity of wastewater discharges and compliance with State water quality standards that prohibit the discharge of toxic pollutants in toxic amounts, or otherwise provide for the maintenance and propagation of a balanced population of aquatic life. Promulgated in 1989, NPDES regulations at 40 CFR 122.44(d)(1) establish specific procedures for determining when water quality-based effluent limits (WQBELs)

for WET are required in permits and specify that the level of water quality achieved by such WQBELs must derive from and comply with State water quality standards.

Background

Basic water quality criteria listed in HAR 11-54-4(a)(4) require all waters to be free of toxic substances at levels or in combinations sufficient to be toxic or harmful to human, animal, plant, or aquatic life, or in amounts sufficient to interfere with any beneficial use of the water. Receiving waters for the Honouliuli WWTP discharge are designated Class A in HAR 11-54-6(b)(2)(B). Designated uses for Class A waters allow for any use as long as the use is compatible with the protection and propagation of fish, shellfish, and wildlife. Class A objectives also state: These waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with criteria established for this class.

The applicant's existing 301(h) permit requires monthly effluent monitoring for chronic toxicity by exposing two test organisms, *Ceriodaphnia dubia* (a water flea) and a Hawaiian sea urchin species, to a composite sample of diluted final effluent. The applicant uses *Tripneustes gratilla* as the sea urchin test species. The Honouliuli permit requires the applicant to conduct WET tests according to the methods described in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms (EPA/600/4-89/001, March 1989) and Adaptations of the Sperm/Fertilization Bioassay to Hawaiian Sea Urchin Species (P.A. Dinnel, June 1988). Data collected under the existing permit are used to evaluate compliance with the 301(h) criteria, including water quality standards.

The toxicity of an effluent can be described using Toxic Unit $_{\text{Chronic}}$ (TU_c) or the No Observed Effect Concentration (NOEC).[4] Permit limits are often written in terms of TU_c. Hawaii's water quality standards use NOEC, but Hawaii routinely writes permit limits in terms of TU_c. This analysis will discuss toxicity using both measures.

In addition to the narrative water quality standard described above, Hawaii water quality standards include a specific requirement for submerged outfalls, such as that at Honouliuli. For continuous discharges through submerged outfalls, HAR 11-54-4(b)(4)(A) requires the NOEC, expressed as a percent of effluent concentration, to not be less than 100 divided by the minimum dilution. EPA has calculated that the minimum dilution for the proposed Honouliuli discharge is 118:1. Consequently, the measured NOEC must be at or greater than 0.847 percent of effluent concentration to meet the current water quality standards at HAR 11-54-4(b)(4)(A). In equivalent terms, the toxicity of the effluent must be less than or equal to 118 TU_c.

[4] The NOEC is the highest tested effluent concentration that does not cause an adverse effect on the test organisms (i.e., the highest effluent concentration at which the values for the observed responses are not statistically different from the control). The TUc is the reciprocal of the effluent concentration that causes no observable effect on the test organisms by the end of the chronic exposure period (i.e., 100/NOEC). Thus, the higher an effluent's TUc rating, the more toxic the effluent. This is discussed in more detail in EPA's TSD (1991).

Pursuant to the existing Honouliuli permit, the applicant is required to use the Dinnel WET test protocol (1988), which measures fertilization success in a Hawaiian sea urchin species. The Dinnel protocol does not suggest a fixed sperm:egg ratio for each species. Instead, the Dinnel protocol requires that an optimum sperm:egg ratio be derived by conducting tests with varying densities of sperm and fixed levels of eggs and subsequently determining fertilization success. To increase the sensitivity of the test and avoid excess sperm densities, the Dinnel protocol requires a mean control fertilization rate between at least 60% to less than 100%. To achieve this, the permittee would need to adjust the sperm:egg ratio with every test to improve consistency in control fertilization. USEPA (1995) has provided further guidance on conducting a trial fertilization to reduce the possibility of a failed test due to control fertilization outside of the method requirement. The Dinnel protocol was followed in 1993 by a method developed by Diane Nacci of EPA's Environmental Research Laboratory in Narragansett, RI. Nacci's standard operating procedure for conducting a toxicity test using the Hawaiian sea urchin *T. gratilla* allows for a sperm:egg ratio of 2500:1. Although this revision was incorporated into several CCH permits by HDOH and EPA (including the Sand Island WWTP permit) over the past ten years, it was never incorporated into the Honouliuli NPDES permit. Published work conducted at the applicant's laboratory subsequent to Nacci's procedure explains how the fixed sperm:egg ratio used by Nacci reduces the chances of meeting acceptable control fertilization (Vazquez, 2003). The applicant began using the fixed 2500:1 ratio in WET sea urchin tests conducted on effluent from the Honouliuli treatment plant in November 2003 and continued to do so until August 2005. The applicant indicated the 2500:1 ratio causes 100% fertilization in the control (Takamura, 16 September 2005 letter). Thus, an incorrect sperm:egg ratio was used by the applicant during this period. Starting in September 2005, after discussions with EPA's Region 9 Laboratory about the test procedure, the applicant reverted to conducting a fertilization trial with each test. This change resulted in the applicant using an optimum sperm:egg ratio that would improve the chances of meeting the control fertilization criterion for *T. gratilla* tests and lessen the chances of producing a false result.

EPA's review of the 301(h) application and effluent data was complicated by the applicant's lack of a flow meter for more than three years. Although continuous flow monitoring of influent and effluent is required by the existing permit, between July 2000 and December 2003 the treatment plant did not have a flow meter to measure the final effluent discharge. During this period, the applicant reported the effluent flow rate as an estimate from the influent flow rate while admitting that numerous variables in the treatment process (e.g. return of unused reclaimed water, backwash from the reverse osmosis filter, and brine) affected effluent flow rates. During this three-year period, the applicant did not provide accurate and certified WET test results on DMRs to EPA, as required by the permit. Instead, the applicant provided toxicity data separate from the DMRs.[5] The permit requires the applicant to conduct WET tests on composite effluent

[5] The applicant's DMR from June 2003 contains the following statements: "The effluent flow meter has not been used since July 2000 because it started reading higher than the more reliable influent meter. The effluent composite sampler is using the influent meter to determine the flow-weighted proportions for the composite effluent sample. Due to lag time between the influent and effluent flows, the effluent composite

samples. In a composite sample, the volume of each individual portion is directly proportional to the discharge flow rate at the time of sampling during the 24-hour sampling period. Without an accurate flow rate measurement, it is not possible to produce an accurate composite effluent sample for further analysis of effluent quality.

Application and Data Review

The application, which summarizes WET test results for the four and one-half year period between 2000 and 2004, indicates all WET tests in 2000 and 2001 complied with the current permit limit of 159.7 TU_c.[6] A failure of the monthly WET test using *T. gratilla* occurred in March 2002 and was followed by accelerated testing which revealed intermittent toxic events. According to the applicant, toxicity was not detected at a level greater than the permit limit between May and August 2002 (although additional data submitted by the applicant [Takamura, 16 September 2005 letter] in response to an information request by EPA reported a test result from May 3, 2002, that was greater than 635 TU_c). The permit limit was again exceeded using *T. gratilla* tests in September 2002, and toxicity in excess of the permit limit was observed in the following weekly samples. The applicant indicated that this toxicity was associated with particulate material and was partly organic in nature. Weekly testing of effluent with *T. gratilla* continued to show intermittent toxicity in excess of the permit limit through July 2003 when monthly monitoring resumed. An exceedance of the current permit limit (159.7 TU_c) in tests conducted with *T. gratilla* in May 2004 triggered the applicant to conduct six weekly tests, which did not show persistent toxicity. The applicant indicated all tests with *C. dubia* fell below the permit limit.

Due to the incorrect Nacci procedure conducted by the applicant from November 2003 to August 2005 and the lack of a flow meter from July 2000 to December 2003, EPA focused its review on the toxicity test results, reported in DMRs, for *C. dubia* beginning in December 2003 and *T. gratilla* beginning in September 2005 through November 2006.

EPA's review determined that all *C. dubia* tests since December 2003 met the water quality standard, applied to this submerged outfall, of 118 TU_c [HAR 11-54-4(b)(4)(A)].

EPA also reviewed WET data from tests conducted with *T. gratilla*. The TU_c and NOEC values resulting from toxicity tests conducted since September 2005 are listed in Table 19. Twelve of the 15 monthly average results exceed the water quality standard, and 14 of the 15 daily maximum values exceed the standard of 118 TU_c.

Since 1996, CCH has been mixing portions of highly treated wastewater from secondary and tertiary treatment processes with primary effluent prior to discharge. Test samples for effluent analyses are collected in the effluent afterbay, downstream of where these separate wastewater streams mix. The proposed discharge in the 301(h) application,

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sample proportions may thus be skewed. All results related to the effluent composite sample are thus not entered on the DMR but are listed separately."

[6] This limit is less stringent that would be appropriate today because of a different calculation of initial dilution.

however, allows for lower quality of effluent. This blending effectively dilutes the toxic effect occurring in the primary effluent and obscures our understanding of whether the effluent from primary treatment alone would meet the water quality standard of 118 TU_c. Despite the addition of highly treated wastewater streams from secondary and tertiary treatment processes, the applicant continually fails to meet the current water quality standard of 118 TU_c (or the current permit limit of 159.7 TU_c). Without the disposal of secondary and tertiary treated wastewaters along with primary effluent, an even higher rate of exceedance is expected. As the applicant increases reuse of treated wastewater, highly treated dilution water for ocean discharge will be less available and our review predicts routine exceedances of the water quality standard of 118 TU_c for chronic toxicity by the Honouliuli discharge.

There is also a limited amount of data from toxicity tests conducted on Honouliuli's primary effluent, without the addition of more highly treated wastewater streams. These data, in the following table, show that toxicity test results from primary effluent exceeded the water quality standard in all three samples. The mixed effluent also exceeded the water quality standard in all three samples, but to a lesser magnitude.

The permit requires the applicant to increase toxicity test frequency to once per week when a WET limit is violated. The frequency must remain at once per week until six consecutive tests have met the limit. Within 45 days of two consecutive WET test failures, the permittee is required to submit for EPA approval a plan and schedule for conducting a Toxicity Reduction Evaluation (TRE).

After exceedances in 2002 and 2003, the applicant submitted vague outlines for conducting a TRE. These TRE's were not approved by EPA. As a result of repeated exceedances of WET tests with *T. gratilla* in September 2005, the applicant submitted a plan for conducting a TRE to EPA on November 4, 2005. EPA reviewed the plan but withheld approval contingent upon the addition of more information and organizational structure. The applicant submitted another TRE plan as the result of two consecutive WET failures that occurred in May 2006 (Takamura, 21 June 2006 letter). This plan is more thoroughly written than previously submitted plans, but it is still not approvable without additional revisions. EPA advised the applicant of the needed improvements on September 11, 2006, but a revised plan has not yet been submitted or approved. All other exceedances, in addition to those described above, triggered the requirement that the applicant conduct a TRE based on an approved TRE plan. Since May 2006, there have been additional exceedances that required the applicant to perform a TRE. Without conducting a TRE, it is unlikely that the toxicants causing chronic toxicity will be identified.

Conclusion

The differing toxicity results between the two test organisms, *C. dubia* and *T. gratilla*, clearly identify the need to assess more than one test species in order to protect all aquatic life in the receiving water. EPA recommends periodic testing for toxicity using an alga, invertebrate, and vertebrate species and then using the most sensitive species for monitoring the toxicity of effluents in WET tests (USEPA, 1991). Tests conducted with

Honouliuli treatment plant effluent using *C. dubia* do not detect the toxicity that is observed in WET tests conducted using *T. gratilla*.

Nevertheless, results from WET tests using *T. gratilla* clearly indicate that the Honouliuli effluent routinely exerts a toxic effect that is predicted under critical conditions to exceed water quality standards at the boundary of the zone of initial dilution. As the likely worst case scenario for the proposed discharge would result in a poorer quality effluent, it is likely that the proposed discharge would be more toxic than the past discharge. Thus, EPA concludes that the proposed discharge will not attain water quality standards for WET and that the proposed discharge will contain substances at levels, or in combinations, sufficient to be toxic to aquatic life, in violation of HAR 11-54-4(a)(4), and, therefore is not protective of uses for Class A waters.

d. Nutrients

Hawaii Administrative Rules (HAR 11-54) contain numeric water quality standards for open coastal waters for the following nutrient parameters: total nitrogen, ammonia nitrogen, nitrate + nitrite nitrogen, total phosphorus and chlorophyll *a* (phytoplankton indicator) as shown below.

Hawaii "Wet" Nutrient Standards for Open Coastal Waters			
PARAMETER (in ug/L)	Geometric Mean not to exceed given value	Value not to exceed more than 10% of time	Value not to exceed more than 2% of time
Total Nitrogen	150.00	250.00	350.00
Ammonia Nitrogen	3.50	8.50	15.00
NO3 + NO2-N	5.00	14.00	25.00
Total Phosphorus	20.00	40.00	60.00
Chlorophyll *a*	0.30	0.90	1.75

The waters of Mamala Bay are classified by the State of Hawaii as Class A open coastal waters. The protected beneficial uses in this class are recreational, aesthetic enjoyment and the support and propagation of fish, shellfish, and wildlife. Nutrient standards are designed to protect aquatic life by preventing eutrophication. In a eutrophic situation, an increased concentration of nutrients promotes algal blooms. When the algae die off, the oxygen concentration in the waterbody can be depleted so severely that other aquatic life cannot be maintained.

For Class A open coastal waters, the State has two sets of water quality standards: a "wet" set applies when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile; and, a "dry" set applies when the

open coastal waters receive less than three million gallons per day of fresh water discharge per shoreline mile. Prior to year 2000, the State of Hawaii applied the "dry" set of criteria based on the historical trend of freshwater discharge per shoreline mile to the coastal waters off Ewa Beach.

In 2000, the CCH modified the receiving water designation off the Ewa Plain from "dry" to "wet" in the City's Water Quality Management Plan (WQM or 208 Plan). The basis of the modification was the volume of fresh water discharged from the Pearl Harbor Estuary through springs and perennial streams, using stream flow data as far back as 1981. The HDOH reviewed the freshwater discharge assessments and approved the modification in the CCH WQM.

The existing NPDES permit does not require effluent monitoring for nutrients. Instead, the permit requires quarterly receiving water monitoring for nutrients at all ZID, ZOM, and reference stations. The permit does not require nutrients to be monitored in the nearshore stations.

In the application, CCH provided nutrient summaries taken from AARs for the years 1994 through 2003. In addition to the information contained in the application, CCH provided EPA with a database of results from all nutrient monitoring conducted in the receiving water over the 16 years from 1991 through 2006. In addition, EPA also reviewed the AARs from 2004 and 2005, which were prepared and submitted after the application.

In the AARs, the applicant assessed nutrient concentrations on a one-year and also a five-year basis to determine impacts. These assessments were only conducted for ZOM stations; nutrient concentrations at ZID stations were not assessed. Furthermore, from the AAR summaries, it appears that the applicant combined data from all ZOM stations (HM1-HM4) to calculate one overall geometric mean for all four stations. The applicant concluded that all State water quality standards were met for nutrients in the receiving water.

Although the existing permit (page 5) does indicate that the discharge shall not cause water quality objectives for nutrients (total nitrogen, ammonia nitrogen, nitrate + nitrite, total phosphorus, and chlorophyll *a*) to be violated in ocean waters beyond the ZOM, 301(h) regulations require all water quality standards and criteria to be met at the ZID. 40 CFR 125.62(a) requires State water quality standards to be met at the ZID boundary. Therefore, for purposes of this 301(h) review, EPA assessed receiving water monitoring data from 1991 through 2006 at both the ZID and ZOM stations.

Initially, EPA assessed the annual geometric mean for each nutrient parameter at each monitoring station (all depths combined). This initial and more general assessment indicated that each station met the Hawaii water quality standard for total nitrogen, nitrate + nitrite nitrogen, and total phosphorus, and chlorophyll a. Annual geometric means for ZID stations ranged from 84 to 137 ug/L for total nitrogen; 1.0 to 1.8 ug/L for nitrate + nitrite nitrogen; 5 to 13 ug/L for total phosphorus. Furthermore, EPA assessed all

individual sample results at each station and each depth and concluded that all three criteria levels (i.e., geometric mean, 10%, and 2% limits) of the State water quality standards for these four parameters were met. Consequently, it was not necessary to conduct a further assessment to determine the geometric means for these parameters at the three individual depths since all water quality standards were met in each individual sample.

However, Hawaii's water quality standards for ammonia nitrogen and chlorophyll *a* were not met. There were individual sample exceedances of the State's geometric mean criteria for ammonia nitrogen, which is 3.5 ug/L in open coastal waters. These exceedances prompted EPA to develop an annual geometric mean for each station, as a general tool to begin assessing attainment of the Hawaii water quality standards for ammonia nitrogen. Geometric means developed for each station are listed in Table 21. The annual geometric mean for total ammonia in the entire water column for the years 1991 to 2006 ranged from 1.2 to 6.3 ug/L at the ZID stations; 1.1 to 3.5 ug/L at the ZOM stations; and 1.1 to 3.7 ug/L at HB6. This initial assessment indicated that the annual geometric mean value for ammonia exceeded the ammonia criteria at station HB5 in seven of the 16 years assessed. This assessment also revealed exceedances in three of the four ZID stations (HB3, HB4, HB5) in the years 1991, 1999, and 2006.

To further assess attainment of the Hawaii water quality criterion for ammonia nitrogen, EPA calculated a geometric mean for ammonia data from each station at each depth. Exceedances of the ammonia nitrogen geometric mean criteria (i.e., 3.5 ug/L ammonia nitrogen) at the bottom, mid-depths, and surface are shown in Tables 22, 23, and 24.

At the bottom depth, all four stations at the ZID boundary exceeded the geometric mean criterion for ammonia nitrogen in 1991, 1998, 1999, 2002, and 2006 (Table 22). The criterion was exceeded at two ZID stations in six years and at one ZID station in four years. There was only one year, 1992, when the geometric mean criterion was not exceeded at any station in the bottom depth of the receiving water surrounding the Honouliuli WWTP outfall.

Exceedances of the geometric mean at the surface and mid-depth stations were not as frequent as bottom depth exceedances, but they did occur, as shown in Tables 23 and 24. In the surface samples, there was one exceedance of the State ammonia nitrogen criteria at station HB5 in 1993 and one exceedance of the criteria at station HB6, located beyond the ZOM boundary, in 1999. In the mid-depth samples, all four ZID stations exceeded the State criteria in 1993. At least one ZID station exceeded the ammonia criteria in eight of the 16 years reviewed. Therefore, in half the years reviewed, at least one of the four ZID stations did not meet the criteria at the mid-depth.

Chlorophyll *a* concentrations also exceeded the criterion. Annual geometric means of chlorophyll *a* concentrations ranged from 0.1 to 0.36 ug/L, exceeding the criterion of 0.30 ug/L. In 1991, the geometric mean criterion was exceeded at ZID stations HB2 and HB5, ZOM station HM2, and reference station HB1. Further analysis of the data by depth indicated that the bottom samples at ZID stations HB2, HB3, HB4, and HB5; ZOM

station HM2; and reference stations HB1 and HB7 exceeded the geometric mean criterion. Surface samples at stations HB1, HB2, HB5, and HM1 as well as the middle samples at HM2 exceeded the geometric mean criterion.

In 1997, the criterion was exceeded at ZID station HB4 when sample results for all depths at this station were combined. When each station was analyzed by depth, the geometric mean criterion at the bottom depths of ZID stations HB3, HB4, HB5, ZOM station HM4, station HB6 beyond the ZOM, and reference stations HB1 and HB7. The surface sample at station HM1 and the middle samples at stations HB4 and HB7 exceeded the criterion also. Exceedances at the reference stations were often at the middle and bottom depths, indicating that the exceedance was caused by the effluent plume.

Conclusion on Nutrients

Overall, EPA concludes that the receiving water of the Honouliuli outfall has not exceeded the Hawaii water quality criteria for total nitrogen, nitrate + nitrite, and total phosphorus. However, the Hawaii water quality criteria for ammonia and chlorophyll *a* were exceeded at all depths. Therefore, the applicant has failed to demonstrate that it can consistently attain State water quality standards.

e. pH

The applicant has not requested a variance for pH. Nevertheless, State water quality standards for pH must be met at the ZID. Hawaii water quality standards for Class A open coastal waters state that pH shall not deviate more than 0.5 units from a value of 8.1 (i.e., within a range of 7.6 to 8.6).

The existing permit requires influent and effluent pH monitoring five days per week. The applicant records monthly average and daily maximum pH values on DMR forms. The existing permit also requires the applicant to conduct quarterly pH monitoring of receiving water at the ZID boundary (monitoring stations HB2-HB5), within the ZID (HZ), at the ZOM boundary (HM1-HM4), beyond the ZOM boundary (HB6), at two reference stations (HB1 and HB7), and at the nearshore stations (HN1-HN4).

The application includes annual assessment summaries of pH data for monitoring events conducted from 1994 through 2003. A discussion of receiving water column samples in the application indicates that ambient pH values ranged from 7.75 to 8.06 at reference stations HB1 and HB7. The application also states that field monitoring of pH has shown that there is less than a 0.10 difference between pH readings at reference and zone of mixing stations. Yet, in the same section of the application, the applicant indicates that receiving water pH ranged from a minimum of 7.9 to a maximum of 8.26. The applicant indicated that monthly average effluent values for pH have ranged from 6.61 to 7.13 over an unidentified five-year period.

EPA reviewed CTD data collected on a quarterly basis during the years from 2000 through 2006. The CTD monitoring instrument records a continuous depth profile from samples taken at each meter between the surface and bottom of the water column. Monitored pH values ranged between 7.84 and 8.39 for all stations and all depths for the years 2000 through 2006. EPA also reviewed pH data submitted in annual reports from 1997 through 1999 for these same monitoring stations. Monitored pH values ranged between 8.04 and 8.41 for all stations described above and all depths in the years from 1997 through 1999.

Receiving water at and beyond the ZID met the State water quality standard for pH for the years seven reviewed. The applicant did not describe in a more detailed manner how the proposed effluent will affect pH values, but, based on past receiving water data, EPA concludes it is likely that the projected discharge will not exceed the State water quality standard for pH in the receiving water.

2. Impact of Discharge on Public Water Supplies

40 CFR Section 125.62(b), which implements CWA Section 301(h)(2), requires that the discharge must allow for the attainment or maintenance of water quality which assures protection of public water supplies. The applicant stated that there were no existing or planned public water supplies which derive water from nearshore marine sources on the Island of Oahu. The application contains a copy of a letter from the CCH's Board of Water Supply stating that the HWWTP would not affect existing water sources (Sato, 8 December 1997 letter). Therefore, EPA has concluded that this criterion is satisfied.

3. Impact of Discharge on Shellfish, Fish and Wildlife

40 CFR 125.62(c)(2) requires that a balanced indigenous population (BIP) of shellfish, fish, and wildlife must exist immediately beyond the ZID and in all other areas where marine life is actually or potentially affected by the proposed discharge. A BIP is defined in the section 301(h) regulations [40 CFR 125.58(f)] as an ecological community which exhibits characteristics similar to those of nearby, healthy communities existing under comparable but unpolluted conditions. The terms shellfish, fish and wildlife should be interpreted to include any and all biological communities that might be affected by the discharge.

There are three types of information available to EPA related to the impacts of the proposed discharge on marine life: biological data (marine organisms collected in the vicinity of the outfall), whole effluent toxicity data, and chemical-specific water and sediment quality data. EPA has established guidance that addresses this situation. EPA's Technical Support Document for Water Quality-based Toxics Control (1991) says:

> It is EPA's position that the concept of "independent application" be applied to water quality-based situations. Since each method (chemical-specific, whole effluent, and bioassessment) has unique as well as

> overlapping attributes, sensitivities, and program applications, no single approach for detecting impact should be considered uniformly superior to any other approach. For example, the inability to detect receiving water impacts using a biosurvey alone is insufficient evidence to waive or relax a permit limit established using either of the other methods.

In this section, we review and integrate the available data on the effects of the proposed discharge to marine life.

a. Review of Biological Data

i. Plankton

The existing 301(h) permit does not require any definitive plankton studies. The applicant addressed this section by concluding there is no evidence to suggest adverse impacts based on field observations. The effects on zooplankton have not been studied since the original AECOS survey (1983) in Mamala Bay, which were inconclusive. However, Edward Laws, University of Hawaii, prepared a data assessment relevant to phytoplankton as part of the 1993 Evidentiary Hearing written testimony. In response to this preliminary hearing of a lawsuit initiated by Hawaii's Friends and the Sierra Club Legal Defense Fund in 1993, Laws analyzed phytoplankton data from February 1985 through August 1991 collected near the Barbers Point outfall. The researcher compared the results to his earlier studies (1981-82) when there was little or no discharge from the outfall. He concluded that there was no evidence the outfall was having an impact on the phytoplankton community.

ii. Benthic Infauna

The applicant has been monitoring benthic infauna community structure at stations near the outfall and at reference stations in 1986, and annually from 1990 to the present. The applicant's evaluation addresses results through 2003. All sampling was performed during the same season (January-February), as directed by the permit, except in 1993 when sampling was performed in June. Community parameters used by the applicant for evaluation include abundance, number of species, diversity, evenness, and overall species composition of the benthic community. Based on these analyses within the sample years, the applicant concluded that there has been no consistent spatial pattern that would indicate an effect on the near-ZID stations. Similarly, the applicant concluded that no pattern of temporal change that could be attributed to the influence of the discharge was evident in any of the parameters analyzed and that a BIP is being maintained.

Summaries of the general methods and results of investigations are presented in Appendix C of the Application and the AARs. As described in the existing NPDES permit, the seven benthic stations are sited at the same depth as the discharge and sampled concurrently with the annual sediment quality sampling. Stations HB1 and HB7 were designed to be outside the influence of the discharge. Micromolluscan and non-micromolluscan components of the benthic infauna were collected.

Spatial patterns of organism abundance and taxa richness in relation to the outfall varied depending on the taxonomic group. Results showed no consistent, statistically significant patterns of reductions of either organism abundance or taxa richness of non-molluscs and molluscs (Swartz et al., 2006). In general, the dominant mollusc taxa were nearly identical at all stations.

In appendix C of the application, CCH indicated that Nelson et al. (2001) conducted a temporal and spatial analysis of all monitoring data for 1986 and 1990 through 2000 and identified a general increase in total non-mollusc abundance over this period. However, there is no consistent spatial pattern in the historic abundance or taxa richness of either non-molluscs or molluscs that indicates an effect of the outfall effluent. Taxa diversity (H') and evenness (J) values show no discernable pattern of reduced diversity or evenness at the ZID or near-ZID stations. In general, diversity and evenness were similar across all stations. Further, there is no indication of a marked alteration in the benthic community in terms of species composition. Responses of the benthic community and sediment analyses provided no indication of the types of changes expected in the benthic community associated with organic enrichment.

iii. Fish and Coral Reefs

The existing 301(h)-modified permit requires impact analyses on biological community structure both at the outfall terminus and at inshore coral reef areas. At the outfall terminus, the existing permit requires fish to be identified, counted, and photographed (using video tapes) along fixed length transect lines using a remote-operated vehicle (ROV) camera. The purpose of this survey is to measure temporal changes in fish assemblages. The permit also requires divers to make visual observations of fish by utilizing three line-transects parallel to the 30 foot isobath, inshore at nearshore station HN2 at a depth of 9 m (30 ft).

Additionally, the permit requires the applicant to assess the impact of the HWWTP discharge on coral communities in the Barbers Point area. The focus of the assessment is to detect changes in living coral coverage. The permit requires this assessment to include a study of reef fishes.

Outfall Terminus

Starting in 1992 and continuing to 2006, with the exception of the year 2000 when equipment malfunctioned, video recordings of the fish communities were conducted for the applicant by Dr. Richard Brock, a researcher at the University of Hawaii. Using a remotely controlled video camera system, annual video recordings were conducted by Brock over the entire length of the diffuser, about one to 1.5 m above the diffuser. Additionally, three transects were established along the diffuser pipe, to assess approximately 31% of the diffuser.

The survey of the outfall indicated that fishes have taken up residence along most of the length of the outfall. The researcher indicated that results of the annual surveys to date

indicate that the fish communities around the diffuser are dominated by species that are either small as adults or by juveniles of larger species. This probably results from the presence of only small-scale shelter created by small armor rock and gravel used in constructing the discharge pipe (Brock, 2006a).

Table 2 of Brock's 2006 report contains a summary of the physical and biological characteristics at the three transects along the diffuser from 1992 to 2006, except for the year 2000. Data contained in the 14-year summary found in Table 2 of the report indicate the number of individual fish ranged from 20 to 402 in transect 1; 32 to 489 in transect 2; and 35 to 221 in transect 3. Table 2 of the study also indicates the number of fish species observed at each transect for this same period of years. The number of recorded fish species ranged from 9 to 19 at transect 1; 6 to 17 at transect 2; and 4 to 13 at transect 3.

Brock's report indicates that fish census data are highly variable. Poor camera resolution, differing angles of the camera, small fish sizes, and avoidance of the approaching camera result in highly variable fish census data. Consequently, these data are considered by the researcher to be more qualitative than quantitative. In general, Brock found little significance attached to any change noted in the fish communities residing on the Barbers Point diffuser because of the variable quality of the data generated by use of the remotely controlled video system.

Appendix C, Attachment C-3 of the application presents a fish health assessment. The applicant stated that the external and internal conditions of fish caught near the diffuser were assessed as an indicator of the health of the fish community impacted by the discharge. The assessment of external conditions included visual examinations to document abnormal growths, atypical color patterns, parasites, fin lesions, skeletal anomalies, and tumors. Liver tissues were evaluated for parasites and pathological conditions. The application indicates that these annual visual assessments and histopathological studies of fish caught near the outfall have been conducted since 1997. Fish surveyed were species of commercial and recreational importance to local fishermen. All fish surveyed from 1997 to 2003, on an annual basis, appeared to be healthy. The applicant reported there was no evidence of acute or chronic disease symptoms, fin erosion, tumors, increased parasitism, atypical coloration, or other signs of disease. No gross abnormalities resembling tumors or microscopic examination of livers were reported. Reports of liver examinations conducted for the applicant in 2005 and 2006 were also reviewed by EPA. Findings for these years were similar to the findings from previous years (Work, 2005, 2006).

In the application, CCH indicated that inquiries to the Department of Land and Natural Resources, HDOH, and fisheries specialists, as well as a literature review, revealed no known instances of mass mortalities of marine organisms have occurred due to oxygen depletion, high concentrations of toxics, or other conditions caused by the HWWTP discharge.

Coral Reefs

Coral colonies exist in areas inshore of the diffuser at depths of 9.2 - 18.3 m (30 -60 ft). Most of what is known about the Honouliuli nearshore environment is the result of continued monitoring studies as part of the Barbers Point Ocean Outfall Monitoring Program.

The Ocean Outfall Monitoring Program, conducted by Dr. Brock using the same experimental design used for the Sand Island coral community, was initiated in August 1991 and focused on impacts inshore from the Barbers Point outfall. Three permanent sites were selected and marked with two transects each for repeated sampling over time**.** One monitoring site (BP-1) was located 2.2 km inshore and to the east of the outfall terminus at about the 49-52 foot depth contour; the second site (BP-2) about 1.5 km inshore and about 250 m east of the outfall pipeline at the 29-37 foot depth; and the third site (BP-3) was located 3.3 km west of the diffuser terminus at about the 55 foot depth. The application indicates that the first survey was conducted in August 1991 for fish and macroinvertebrates and the second in January 1992 for coral species. A third survey was conducted for all three parameters in May 1993, when a fourth monitoring site was established. Since then, these permanently marked sites have been surveyed annually.

The working hypothesis for this study was the same as that for the Sand Island coral community study: since all study sites are situated in relatively shallow reef areas, they are most probably outside the influence of the present deep water outfall. However, if any impacts are occurring shoreward of the diffuser, they are probably chronic in nature and gradients of stress should become evident with distance from the impact source(s). Thus, a long-term monitoring study should be able to quantitatively discern these impacts. Unfortunately, any impacts subsequent to commencement of the marina construction, being much closer to the station sites, would likely overwhelm any perceptible impacts from the Honouliuli effluent and thus negate any monitoring value the study might have for the outfall. Given this caveat, presented below is an assessment of impacts on the coral community parameters investigated. Field sampling took place in 1991, and annually from 1993 to 2006. The stations were positioned to assess predicted gradients of impact that may be created by the discharge and movement of the treated sewage effluent toward the shore and the coral reef communities (Brock 2006b).

Despite some differences in parameters among the surveys, Kruskal-Wallis ANOVA results show no statistically significant changes among means over time for coral cover and number of species, invertebrate abundance and number of species, fish abundance and number of species, and standing crop at each station. The Student-Neuman-Keuls multiple range test also demonstrated no statistically significant differences in these parameters among the transects and sample periods. Three relatively large endangered green sea turtles (*Chelonia mydas*) were observed near two of the ocean outfall transects during the 1995 survey.

Data from the 15 annual surveys indicated that no statistically significant change has occurred in the measured biological parameters at the four stations, despite the occurrence of a major hurricane on the marine communities in September 1992 (Brock

2006b). Data from the 15 year studies show that, to date, the operation of the Barbers Point ocean outfall is not having a quantifiable negative impact on the coral reef resources situated inshore of the outfall terminus.

Sand scour appeared to be another negative factor in the development of coral communities on the limestone flats. Similarly, if sewage effluent played a role in eliminating corals from both the limestone flat and armor rock covering the outfall, then corals should be rare or absent from both locations. To test these hypotheses, station BP-4 was established in 1993, with transect BP-4A located on the basalt armor rock over the outfall and transect BP-4B approximately 15 m to the east on the flat limestone substratum. Results indicated that the benthic coral, macroinvertebrate and fish communities are well developed on the elevated armor rock and poorly developed on the adjacent limestone flat that is subject to periodic scouring. Also apparent was the fact that the corals at transect BP-4A show a considerable range in size on the armor rock, and the largest corals were no older than the length of time since outfall construction when the armor rock was placed. The smaller corals represent more recent recruitment events. Thus, the range in sizes of corals shows that their recruitment has continued despite the Honouliuli discharge.

b. Review of Whole Effluent Toxicity Data

The available data on whole effluent toxicity were reviewed in section 3.1.c above to assess whether or not the proposed discharge would exceed water quality standards. EPA found that the proposed discharge would likely frequently exceed the HDOH water quality standard for whole effluent toxicity.

c. Review of Chemical-specific Water Quality Data

The available data on chemical-specific water quality data were reviewed in section 3.1. above to assess whether or not the proposed discharge would exceed water quality standards. EPA found that, of the standards established to protect aquatic life, the proposed discharge would exceed the standard for ammonia.

d. Review of Sediment Quality Data

Suspended solids in the wastewater discharge can result in changes in receiving water quality by lowering the dissolved oxygen (DO) concentration in near-bottom waters and reducing water clarity and light transmittance in the water column. Both lower DO concentrations and reduced light transmittance can result in changes to biological communities in the vicinity of the discharge. The potential for these types of changes in the vicinity of the Honouliuli outfall is reviewed elsewhere in this document.

Transport and Dispersion of Wastewater and Particulates

According to the ATSD, most of the potential biological impacts in the vicinity of a wastewater outfall can be associated with discharged particulate organic matter and the toxic substances adsorbed to them. The sedimentation of suspended particles in the

vicinity of an outfall is influenced by the amount of suspended solids in the wastewater discharge, the settling velocity distribution of the particles in the discharge, the plume height of rise, and current velocities. Consequently, as instructed in the ATSD, the applicant must predict the seabed accumulation that results from the discharge of suspended solids into the receiving water and determine whether these accumulations are substantial for both the annual period and the 90-day period during which the highest sedimentation rate occurs. When seabed accumulation resulting from the discharge of suspended solids to receiving waters is predicted, sediments in the vicinity of the outfall are periodically monitored and evaluated for changes in physical characteristics (e.g., grain size) and quality (e.g., organic material, toxics, etc.). This section examines these types of data collected by the applicant in order to evaluate both sediment enrichment as a result of organic particles accumulating near the wastewater outfall and sediment contaminated by toxic substances.

Sedimentation of Discharged Suspended Solids

The applicant concentrated its discussion of effluent suspended solids on: (1) accumulation rates of organic particulate material based on sediment trap data; (2) resuspension due to currents and surface wave induced near-bottom currents; and (3) prediction of sediment accumulation using the EPA model SEDDEP (Bodeen et al., 1989).

Sediment traps were deployed in the vicinity of the Honouliuli outfall from December 1982 to January 1983, and from May 1983 to June 1983. The applicant provided contour maps showing 15-day accumulations for both winter and summer conditions. The maximum winter and summer accumulations corresponded to 608 $g/m^2/yr$ and 73 $g/m^2/yr$, respectively.

The applicant provided several estimates of settled effluent solids resuspended due to waves. Resuspension due to long-period waves was estimated to occur at depths to 70 m (230 ft), for a total of 77 percent and 61 percent of the time during winter and summer, respectively. The applicant's calculations indicate that resuspension continually occurs by short-period waves at depths down to 21 m (70 ft).

The applicant provided predictions of the expected effluent suspended solids accumulation on the seafloor using EPA model SEDDEP. The maximum accumulation was predicted to be 0.032049 times the effluent suspended solids mass emissions rate over a 0.25-km^2 area.

The applicant's sediment trap and resuspension calculations are reasonable. EPA recalculated the sediment accumulation predictions using the simplified method described in the ATSD and different inputs, including the average upcoast, downcoast, onshore and offshore current speeds of 7 cm/sec, 2.3 cm/sec, and 2.3 cm/sec, respectively. These values are based on variances of filtered current meter data taken at a depth of 70 m (230 ft), as part of the ocean current measurements study (Hamilton, et al., 1996). The particle fall velocity distribution was based on the ATSD distribution for primary or advanced primary effluent. EPA set the bottom slope equal to zero (0), which

is equivalent to the assumption that currents close to the seafloor are parallel to the seafloor. The predicted year-2000 annual average effluent suspended solids mass emission rate of 10,835 kg/day (23,887 lb/day) was used for both the annual steady-state and critical 90-day predictions.

For the steady-state case, the maximum annual average total deposition rate is calculated to be 908 $g/m^2/yr$, with a maximum annual average organic deposition rate of 726 $g/m^2/yr$, over an area of 0.22 km^2. Using these deposition rates, the maximum annual average steady-state organic accumulation was calculated to be 199 $g/m^2/yr$ over the same area. For the critical 90-day case, the organic total deposition rate was calculated to be 118 $g/m^2/90$ days over the same area.

Contaminant Concentrations in Sediments

Since 1991, sediment monitoring studies have been conducted annually, consistent with the terms of the existing permit. Seven stations located along the 61 m (200 ft) depth contour are sampled in January or February of each year. Samples for sediment chemistry and particle size analyses were obtained with a 0.1 m^2 Van Veen sampler until 1994, when a 0.16 m^2 Van Veen sampler was substituted and since used.

High rates of organic accumulation in sediments are usually associated with elevated sediment concentrations of: sediment grain size, silt and clay content, oxidation-reduction potential (redox), total organic carbon (TOC), total Kjeldahl nitrogen (TKN), and oil and grease. Overall, significant accumulation of organic material around (or in the vicinity of) the Honouliuli outfall has not been detected through the applicant's monitoring efforts.

Sediment Grain Size. A review of the applicant's winter data from the seven stations sampled during 1986 and 1990-2003 indicates sediments were predominantly (>90%) sand at all stations. The coarse-sediment fraction was moderately higher and the fine-sand fraction moderately lower at stations HB1, HB2, and HB7, compared to the other monitoring stations. The finer silt and clay content of sediments from these stations is relatively low. The grain size distribution is generally similar among stations, with the exception of reference station HB-7, which had a higher percentage of medium and coarse sand compared to the other stations. There is no apparent trend in the silt and clay content of the sediments in the vicinity of the diffuser. Replicate samples from all seven stations indicated homogeneity in grain size within stations and a two-way ANOVA performed by the applicant showed no significant difference among sample years in percentage of fine grain sediments.

Oxidation-Reduction Potential. Redox values less than zero (0) are considered indicative of highly reducing conditions caused by the decomposition of deposited organic matter and depletion of oxygen in the sediments. Under these conditions, sulfate can be reduced to form toxic sulfide. Values for oxidation-reduction potential showed no evidence of reducing conditions at the surface of sediments at any station. The applicant reported no statistically significant difference among sample years or among stations, after

performing a two-way ANOVA. Results indicate well-oxygenated sediments in the area of the Honouliuli outfall.

Total Organic Carbon. The applicant states that the concentration of TOC measured at the seven stations in any given year (1990-2003) indicates that the organic content of the sediments is relatively low, much less than one percent. No discernible patterns were observed over time or space. Reference station concentrations are consistently high or higher than some ZID stations.

Oil and Grease. The oil and grease method measures the amount of water-insoluble, non-volatile petroleum hydrocarbons present in a sample. This method is not chemical-specific and may include any material extracted from an acidified sample (APHA, 1992). These include sulfur compounds, some organic dyes, and naturally occurring organic compounds (e.g., chlorophyll). Spatial and temporal patterns in oil and grease content in the vicinity of discharge may be expected. Concentrations varied considerably among stations and over time, but statistical analysis of the data showed that these differences were not significant.

Priority Pollutants. There are currently no numeric criteria for priority toxic pollutant contaminants in sediments. However, there are marine reference levels found in NOAA Screening Quick Reference Tables (NOAA, 2006), which can serve as guidelines for determining the potential for adverse effects on benthic organisms. Of particular concern to EPA are the pesticides chlordane and dieldrin because they are present in the Honouliuli effluent at levels which can exceed Hawaii water quality standards. Both chlordane and dieldrin have been detected in sediment samples at ZID boundary station HB4 from a number of annual sediment sampling efforts. Chlordane was detected at HB4 in 1997 (2.1 ug/kg), 2001 (1.6 ug/kg), and two samples in 2004 (2.8 and 2.5 ug/kg). Dieldrin was detected at this same station in January 2004 (0.30 ug/kg). Because both pesticides consistently occur in the effluent at levels which exceed Hawaii water quality standards, the fact that they are also detected in marine sediments in the vicinity of the outfall suggests that the outfall is a source for potential bioaccumulation of these toxics in local fish.

Of the nine metals analyzed by the applicant, eight metals were detected. Median concentrations of these metals measured were similar among stations, but they varied over time. None of the metals showed average or maximum concentrations greater than the respective Effects Range-Low (ER-L) values derived from Long and Morgan (1990), suggesting that no adverse benthic effects are expected using these criteria. Review of this data shows little change in sediment metal concentrations over time and space, except for arsenic. Arsenic concentrations appear to vary little over time, but there is an approximate increase—by a factor of two—from west to east. The two stations with consistently higher concentrations are HB2 at the ZID and Reference Station HB1 nearest the mouth of Pearl Harbor. Even higher values were recorded in 1990 and 1994 within the ZID. There is no apparent explanation for these higher values, as effluent arsenic measurements are consistently below the applicant’s detection limits (10 ug/L).

e. Analysis of Impacts on Shellfish, Fish, and Wildlife

Wastewater discharges can have a variety of impacts on marine life. For purposes of this review, EPA is dividing the types of impacts into two categories: toxic effects and nutrient-related effects. The discharge of nutrients into aquatic environments can cause excessive growth of aquatic plants. In the case of the HWWTP, the most likely adverse effect of nutrient discharge would be phytoplankton blooms.

This section is a summary of EPA's analysis and integration of the biological, whole effluent, and chemical-specific data related to impacts to marine life.

i. Toxic Impacts beyond ZID

The information as to whether the proposed discharge would have a toxic impact on marine life is mixed. Past biological data do not show a detectable toxic impact of the discharge, whereas the discharge often exceeds the water quality standard for whole effluent toxicity.

There are limitations with the biological data. First, the data are not extensive, as monitoring is required only infrequently. Second, the scope of the biological monitoring is limited; only portions of the marine community are sampled. Third, the samples that were collected may not have been collected during critical conditions, for example when initial dilution was at critical levels.

The whole effluent toxicity data indicate that the effluent is often highly toxic. Not only is it usually toxic when accounting for critical initial dilution, the effluent is often so toxic it could produce toxic effects in the ocean even when dilution is much higher.

It is also relevant that the applicant is proposing a lower quality discharge than what has occurred in the past. Thus, toxic impacts are more likely in the future.

Integrating the available information, it is EPA's analysis that the proposed discharge likely would have toxic impacts beyond the ZID.

ii. Nutrient-related Impacts beyond ZID

The information as to whether the proposed discharge would have biostimulatory impacts beyond the ZID as a result of the discharge of nutrients is mixed. Past biological data do not indicate the presence of phytoplankton blooms or other sign of excessive marine plant growth. On the other hand, ambient water quality data for ammonia, a nutrient, indicates that ammonia is sometimes discharged at levels which exceed water quality standards. Likewise, chlorophyll a, a phytoplankton indicator, sometimes exceeds the State's water quality standards in the receiving water.

There are limitations with the biological data. First, data on plankton populations are scarce. Second, the samples may not have been collected during critical conditions.

Therefore, EPA's analysis is that the discharge may have stimulated algae blooms and that the proposed discharge may have nutrient-related effects beyond the ZID.

iii. Impacts within ZID

40 CFR 125.62(c)(3) requires that conditions within the ZID not contribute to extreme adverse biological impacts, including, but not limited to, the destruction of distinctive habitats of limited distribution, the presence of disease epicenter, or the stimulation of phytoplankton blooms which have adverse effects beyond the ZID.

The applicant indicated there are no adverse biological impacts within the ZID caused by the Honouliuli discharge. Video recording of fish near the length of the diffuser revealed a diverse community. Internal and external assessments of fish caught near the outfall did not indicate signs of disease. There is no indication of any marked alteration of the benthic community composition related to the outfall. There were no reports of algae blooms in the ZID.

As described in the preceding section, EPA's analysis is that the discharge may have stimulated algae blooms beyond the ZID and that the proposed discharge could contribute to algae blooms. If these blooms were to occur it is likely that the area within the ZID would be affected as well. EPA does not, however, consider it likely that the proposed discharge would cause algae blooms so severe that they should be characterized as extreme adverse biological impacts.

iv. Conclusion

Although the results of EPA's analysis are mixed, EPA concludes that the applicant has failed to demonstrate to the satisfaction of EPA that a modified discharge would not interfere with the attainment or maintenance of that water quality which assures protection of a balanced, indigenous population of shellfish, fish, and wildlife. Even if the limited biological data were assumed to demonstrate that a BIP is in existence, it is questionable whether it can be maintained given the toxic effects of the discharge and the potential of nutrient enrichment in the area surrounding the outfall.

4. Impact of Discharge on Recreational Activities

The following section describes the potential for impacts on recreational activities from the effluent discharge. Under section 40 CFR 125.62(d), the applicant's proposed modified discharge must allow for the attainment or maintenance of water quality which allows for recreational activities at and beyond the zone of initial dilution, including, without limitation, swimming, diving, boating, fishing, picnicking, and sports activities along shorelines and beaches.

Recreational areas are present within an 8-km (5-mi) radius of the outfall diffuser. These areas include beaches and waters offshore of beaches where activities such as swimming,

snorkeling, scuba diving, boating, fishing, and surfing take place. In 2003, the applicant employed a research firm to conduct a survey measuring usage of the Oahu south shore by island residents to determine recreational uses in the area. The survey results confirmed that residents participated in recreational activities in ocean waters out to two miles from shore and beyond. Residents identified recreational activities including swimming, surfing/bodyboarding/windsurfing, snorkeling, paddling/canoeing/kayaking, fishing, diving, sailing, boating, and waterskiing. Thirty-four percent of the 375 respondents reported frequent recreational use (defined in the study as use at least once every other week) of the south shore. While the majority of recreational activity reported in this survey took place within 300 feet of shore, recreational use beyond two miles from shore was reported by at least five percent of the respondents.

Thus, there are a variety of recreational activities that could occur in the vicinity of the discharge. For purposes of this review, EPA has grouped these into two categories of recreation: fishing (with associated fish consumption) and water contact recreation.

a. Fish Consumption

There are three types of data relevant to the assessment of impacts on the consumption of fish caught as a result of recreational fishing: data on bioaccumulation of toxic pollutants in fish tissue, data on toxic pollutants in the effluent, and data on toxic pollutants in the sediments surrounding the outfall.

i. Review of Data on Bioaccumulation

According to the ATSD, the discharge of sewage effluents containing toxic substances can result in bioaccumulation in the tissues of aquatic organisms. The degree to which pollutants bioaccumulate in aquatic organisms depends on the type of food chain, the availability and persistence of the pollutant, and the physical-chemical properties of the pollutant. Toxic heavy metals and persistent synthetic organic compounds generally have the highest potential for bioaccumulation in marine organisms.

Most toxic pollutants with a high bioaccumulation potential are generally associated with organic particles in an effluent discharge; consequently, substantial bioaccumulation is possible when there is localized accumulation of contaminated sediments in the area around an outfall. Alternatively, as explained in the ATSD, bioaccumulation may not be such a serious problem when there is adequate initial dilution of the discharged effluent in conjunction with sufficient circulation to prevent localized accumulation of solids, or trapping of the effluent plume in the nearfield and farfield. The ATSD also notes that the potential for bioaccumulation will be less if fishes with only transitory plume exposure are present (e.g., pelagic or migratory species), than if demersal species living on or near the seabed dominate in an area of sediment deposition around an outfall.

To determine whether the effects of the Honouliuli wastewater discharge may constitute a threat to public health, the existing 301(h)-modified permit specifies that the applicant monitor pollutant body burdens for priority pollutants and 301(h) pesticides in fish

species consumed by humans and which are representative of species caught by local recreational and commercial fishermen. Once each year, in January or February, the applicant is required to collect fish within the ZID by hook and line, or by setting baited lines and traps. At least three species of common epibenthic fish must be collected. For each species, about ten fish are to be selected at random and muscle tissue and liver tissues removed and (separately) composited. The cumulative total number of composite samples should be at least three. EPA notes that inconsistent units used by CCH to report priority toxic pollutant and 301(h) pesticide data in fish may have confounded the data reviews presented, below.

1991 through 1995

In Appendix G, Attachment 3, of the application, CCH described their methodology for annually collecting, at a location near the Honouliuli outfall, fish species commonly caught and eaten by local recreational and commercial fishermen. During the period 1991 through 1995, the applicant caught, using hook and line, the following three species: menpachi (*Myripristis cheryseres*), akule (*Trachiurops crumenopthalamus*), and ta'ape (*Lutjanus kasmira*), to evaluate bioaccumulation in the vicinity of the outfall. According to the Hawaii Coral Reef Network, *Myrispristis* species (soldier fish) are usually found hiding in cracks, crevices, and caves on the reef during the day. They are primarily nocturnal fishes and feed on the larger zooplankton associated with coral reefs. *Lutjanus kasmira* (blue striped snapper) is a common reef fish living near the bottom and found in shallow to very deep water. They aggregate during the day, but are primarily nocturnal carnivores, feeding on crabs, shrimps and small fishes. *Trachiurops crumenopthalamus* (bigeye scad) are nocturnal carnivores and range widely when foraging for food.

From 1991 through 1995, composite samples of muscle tissue from each of these three fish species were analyzed for a subset of priority toxic pollutants and 301(h) pesticides (trace metals and cyanide, volatile and semivolatile organics, chlorinated pesticides and PCBs) using recommended EPA 301(h) analytical methods. Appendix G, Attachment 3, of the application contains the applicant's evaluation of bioaccumulation data for this period.

From 1991 through 1995, the following pollutants were detected at least once in muscle tissue in one or more of the three fish species sampled: arsenic, cadmium, chromium, copper, mercury, nickel, selenium, silver, zinc, alpha-chlordane, dieldrin, 4,4-DDE, 4,4-DDD, methylene chloride, di-n-butyl phthalate, bis(2-ethylhexyl)phthalate, methoxychlor, and chloromethane. During this period, only arsenic, chromium, copper, mercury, selenium, and zinc were detected three or more times, in one or more of the three fish species sampled. Only arsenic, mercury, and zinc were detected each year in each of the three fish species sampled. The ranges of detected values for arsenic, mercury, and zinc (in mg/kg wet weight or ppm) in comparison to EPA-recommended screening values for recreational fishers and FDA safety levels for fish are provided in the paragraph, below.

EPA-recommended screening values are concentrations of target analytes in fish tissue that are of potential public health concern and that are used as threshold values against which levels of contamination in similar tissue collected from the ambient environment can be compared. Exceedances of EPA's screening values should be taken as an indication that more intensive site-specific monitoring and/or evaluation of human health risk should be conducted. FDA safety levels for fish, in many cases, represent the point at which the FDA will take legal action to remove products from the market; consequently, per the FDA, safety levels are not always suitable for critical limits.

During the period 1991 through 1995, the applicant found that arsenic ranged from 5.9 to 15.5 ppm in menpachi, 1.1 to 8.1 ppm in ta'ape, and 0.40 to 8.1 ppm in akule; these values are above the EPA screening value for recreational fishers of 0.026 ppm inorganic arsenic (where inorganic arsenic is generally found in seafood at concentrations up to 20 percent of the total arsenic concentration). There is no FDA safety level for arsenic in fish. Mercury ranged from 0.026 to 0.13 ppm in menpachi, 0.008 to 0.16 ppm in ta'ape, and 0.034 to 1.28 ppm in akule; only values for akule are above the EPA screening value for recreational fishers of 0.4 ppm methylmercury and the FDA safety level for methylmercury in fish of 1.0 ppm. Zinc ranged from 2.1 to 3.2 ppm in menpachi, 2.3 to 3.66 ppm in ta'ape, and 0.495 to 5.8 ppm in akule; for zinc, there is no corresponding EPA screening value for recreational fishers or FDA safety level.

In Appendix G of the application, CCH states that in all but a few cases, metals concentrations in fish tissue collected near the outfall were consistent with metals concentrations from other areas in the Hawaiian Islands, including areas considered removed from the immediate influences of contaminant input sources. However, CCH only referenced this statement and did not provide the control station location(s) and corresponding detected pollutant concentrations.

<u>1993 through 2004</u>

Appendix J of the application presents a summary of metals concentrations detected in fish muscle tissue samples collected from 1993 through 2004. Samples of akule, menpachi, and ta'ape were caught in the vicinity of the outfall for analysis. The ranges listed in Table 25 were detected, but not all metals were detected each year:

Based on Table J-12, in Appendix J of the application, during this 12-year period (1993 through 2004), only antimony, arsenic, cadmium, chromium, copper, lead, selenium, and zinc were detected six or more times in one or more of the three fish species sampled. During this 12-year period, only arsenic and zinc were detected each year in each of the three fish species sampled.

For antimony, chromium, copper, lead, and zinc, there are no corresponding EPA screening values for recreational fishers or FDA safety levels for fish. The muscle tissue concentration values for arsenic are above the EPA screening value for recreational fishers of 0.026 ppm inorganic arsenic; for arsenic, there is no FDA safety level for fish.

The muscle tissue concentration values for cadmium, methylmercury, and selenium are below the EPA screening values of 4.0 ppm, 0.4 ppm, and 20 ppm, respectively, and the FDA safety level for methylmercury in fish of 1.0 ppm.

Appendix J of the application presents no numerical data for other priority toxic pollutants and 301(h) pesticides; however, the applicant states that neither chlordane or dieldrin were detected in samples of akule, menpachi, and ta'ape sampled near the Honouliuli outfall during this time period (1993 through 2004).

Review of AARs provided by the CCH suggests that the applicant began presenting bioaccumulation data for fish liver in 1999 and began presenting control station data for bioaccumulation in 2002.

2002 through 2005

To supplement the numerical data provided in the application, EPA reviewed fish muscle tissue data for akule, menpachi, and ta'ape submitted by the applicant in the AARs for years 2002 through 2005. EPA notes that inconsistent units used by CCH to report the metals data in fish muscle tissue may have confounded the data review presented, below.

From 2002 through 2005, only the metals: antimony, arsenic, copper, lead, mercury, selenium, and zinc were detected each year in the muscle tissue of one or more of the three fish species sampled. For each of these years, the muscle tissue concentration values for arsenic are above the EPA screening value for recreational fishers of 0.026 ppm inorganic arsenic; for arsenic, there is no FDA safety level for fish. For each of these years, the muscle tissue concentration values for methylmercury and selenium are below the EPA screening values of 0.4 ppm and 20 ppm, respectively, and the FDA safety level for methylmercury in fish of 1.0 ppm. For selenium, there is no FDA safety level for fish. For antimony, copper, lead, and zinc, there are no corresponding EPA screening values for recreational fishers or FDA safety levels for fish.

From 2002 through 2005, only the organic compounds: bis(2-ethylhexyl)phthalate, methylene chloride, and DDT isomers were detected two or more times in the muscle tissue of one or more of the three fish species sampled. The muscle tissue concentration values for DDT isomers are below the EPA screening value 0.117 ppm and the FDA safety level for DDT, TDE, and DDE of 5.0 ppm. For bis(2-ethylhexyl)phthalate and methylene chloride, there are no corresponding EPA screening values for recreational fishers or FDA safety levels for fish.

Based on data collected from 2002 through 2005, there appears to be no regular pattern indicating higher concentrations of metals and organic compounds in fish muscle tissue at the Honouliuli outfall compared to the control station. In 2002, copper and zinc in all three fish species were higher at the outfall compared to the control station. In 2003, selenium in all three fish species was higher at the outfall compared to the control station. In 2004, mercury was higher in all three fish species at the outfall compared to the

control station. In 2005, mercury and selenium were higher in all three fish species at the outfall compared to the control station.

Conclusion

Data provided in the application and AARs indicate bioaccumulation of metals and organic compounds in some of the fish species sampled. The reported fish muscle tissue concentrations for arsenic regularly exceed the EPA screening value for recreational fishers. The reported fish muscle tissue concentrations for mercury and selenium have sometimes exceeded EPA screening values for recreational fishers. Based on the bioaccumulation data presented from 2002 through 2005, including data from control stations, EPA believes that high arsenic levels in fish muscle tissue appear to be a ubiquitous problem not directly related to the discharge of arsenic from the Honouliuli outfall. Although recent levels of methylmercury and selenium in fish muscle tissue are generally measured below EPA-recommended screening values for recreational fishers, EPA cannot rule out pollutants from the Honouliuli outfall—specifically copper, mercury, selenium, and zinc—contributing to bioaccumulation in fish in the vicinity of the Honouliuli discharge.

ii. Review of Data on Effluent Quality

As described in section C.1.b above, EPA found that the effluent often contained levels of chlordane and dieldrin that exceeded water quality standards. These standards were established at levels designed to prevent fish from accumulating carcinogenic compounds in their tissues that would pose a significant health risk to persons who caught and consumed them.

iii. Review of Data on Sediment Quality

As described in section C.3.d. above, EPA found that several priority pollutants were detected in sediments in the vicinity of the outfall, including arsenic, chlordane, and dieldrin.

iv. Analysis of Impacts

The information as to whether the proposed altered discharge would cause bioaccumulation of toxic pollutants in fish that would pose a threat to human health is mixed. While the analysis of fish tissue bioaccumulation does not show elevated levels of chlordane or dieldrin, the effluent data for these pollutants exceeds water quality standards after accounting for critical initial dilution. Additionally, chlordane and dieldrin are present in sediments at the outfall. Moreover, the sediment quality data show that chlordane and dieldrin are present in the sediments around the outfall and are, thus, available for bioaccumulation by local fish.

EPA’s analysis is complicated by the fact that data on bioaccumulation in fish and effluent and sediment quality are very limited. Nevertheless, given the clear exceedance

of water quality standards for chlordane and dieldrin in recent effluent samples and presence in sediments at the outfall, EPA finds that the discharge may have resulted in bioaccumulation of these toxic pollutants in fish. Moreover, the proposed discharge is of a lower quality than the current discharge, so bioaccumulation is more likely in the future. Therefore, it is EPA's conclusion that the proposed altered discharge could cause bioaccumulation in fish at levels that would pose a significant threat to persons who consumed fish caught near the outfall.

b. Water Contact Recreation

As discussed above in Section C.1.a, EPA has concluded that the applicant has failed to show that it can consistently achieve water quality standards for bacteria. Water quality criteria for bacterial indicators protect human health by limiting pathogens in waters designated for recreational uses, thereby reducing the risk of illness resulting from exposure to pathogenic organisms in recreational waters. When water quality standards for bacteria are not being met in waters where there is water-contact recreation, the recreational uses are adversely affected.

In the 2003 survey, residents identified water-contact recreational activities such as swimming, surfing, bodyboarding, windsurfing, snorkeling, diving and waterskiing in waters off the Oahu south shore, including in some cases in waters beyond two miles from shore. As discussed in section C.1.a, the Honouliuli treatment plant discharges to waters categorized in Hawaii's water quality standards as Class A open coastal waters, which are to be protected for recreation "in and on" the waters. EPA's analysis of the bacteria data, as discussed above in Section C.1.a., indicates that although water quality criteria are generally met at the shoreline monitoring stations, discharge from the Honouliuli wastewater treatment plant does not meet water quality criteria at the edge of the zone of initial dilution, at the edge of the zone of mixing, or at the one monitoring station beyond the zone of mixing. In 2006 alone, monitoring data from the 11 offshore stations indicated the geometric mean criterion was exceeded in four of 36 surface samples and 30 of 36 bottom samples, and exceedances of the geometric mean criteria occurred even when surface and bottom samples were averaged. Similarly, in 2006, even the least stringent potential single-sample maximum value of 501 cfu/100 ml was exceeded in nine offshore bottom samples, with exceedances ranging from 510 to 2200 cfu/100 ml at four sites around the ZID and one site around the ZOM. (See discussion in section C.1.a.) As noted previously, the single sample value describes the water quality actually encountered by swimmers and divers on the day the sample was collected, and thus it is a useful tool in determining the risk to persons engaged in water-contact recreation. When this portion of the water quality criteria is not met, swimmers have a greater risk of illness, and, therefore, recreational uses are not protected. For all these reasons, and as discussed in more detail in section C.1.a, EPA concludes that recreational water contact recreational uses are not protected in offshore waters.

c. Conclusion

For the reasons discussed above, EPA concludes that both fishing (fish consumption) and water contact recreation are adversely affected by the applicant's discharges, and that the applicant has not demonstrated that its modified discharge will not interfere with the attainment or maintenance of water quality which allows for recreational activities in and on the water at and beyond the ZID.

5. Additional Requirements for Altered Discharge

Section 40 CFR 125.62(e) states that where the proposed modified discharge is based on an improved or altered discharge, the applicant must demonstrate that the proposed improvements or alterations to the existing discharge have been thoroughly planned and studied and can be completed or implemented expeditiously, and that the improved or altered discharge will comply with the requirements of 40 CFR 125.62(a) - (d).

The basis of the proposed altered discharge is not the result of a planned increase in the 38 MGD design flow of the primary treatment plant. In the year 2020, the applicant anticipates needing to increase the treatment plant design flow, from 38 MGD presently to 51 MGD, in order to accommodate population growth within the service area.

In the present application, CCH has requested an increase in the monthly average BOD_5 limit from 160 mg/l to 200 mg/l. The applicant does not describe how the current treatment facility or operation of the facility will be improved to ensure 30% removal of BOD if the monthly average BOD_5 limit is increased to 200 mg/L.

Since the applicant is proposing an altered discharge that could involve discharge of lower quality effluent, it needs to demonstrate that the proposed discharge will meet the State's water quality standards and protect the BIP and recreational activities. In its analysis, EPA primarily reviewed data from the current discharge. Since EPA concluded that even based on the current discharge, the State's water quality standards will not be met and the BIP and recreational activities will not be protected, and since the future discharge may be of lower quality, EPA concludes that the requirements of 40 CFR 125.62(e) have not been met.

6. Conclusions

Based on a review of the available data, EPA concludes that the proposed discharge will not ensure compliance with the State's water quality standards and will not result in attainment or maintenance of water quality which assures the protection and propagation of a balanced indigenous population of shellfish, fish and wildlife; and allows recreational activities. This conclusion is based on findings that the proposed discharge:

- Would exceed water quality standards for bacteria, chlordane, dieldrin, whole effluent toxicity, chlorophyll *a*, and ammonia;
- Likely would have toxic impacts to marine life beyond the ZID;
- May have nutrient-related impacts beyond the ZID;

- Would not likely cause algae blooms or other events within the ZID so severe that they should be characterized as extreme adverse biological impacts;
- Could cause bioaccumulation at levels that would pose a significant threat to persons who consumed fish near the outfall; and
- Would contain levels of pathogens that would not allow recreational activities.

D. Establishment of a Monitoring Program

Under 40 CFR 125.63, which implements section 301(h)(3), the applicant must have a monitoring program designed to evaluate the impact of the modified discharge on the marine biota, demonstrate compliance with applicable water quality standards, measure toxic substances in the discharge, and have the capability to implement these programs upon issuance of a 301(h)-modified NPDES permit. The frequency and extent of the program are to be determined by taking into consideration the applicant's rate of discharge, quantities of toxic pollutants discharged, and potentially significant impacts on receiving water, marine biota, and designated water uses.

The applicant did not provide a revised monitoring program in the application. The application only provided the existing permit with the monitoring requirements already contained in the permit. Furthermore, CCH indicated in the application that revisions to the present monitoring program were not being requested. Instead, the applicant preferred to wait until EPA's review of the 301(h) variance application indicated the need to revise the 1991 monitoring program.

Appendix I of the application includes the City's organization charts, demonstrating that CCH has the resources to carry out a planned monitoring program. Annual reports contain summaries of the sampling techniques, schedules, and locations.

As discussed throughout this document, the existing monitoring program consists of influent, effluent, and receiving water monitoring. Influent monitoring includes: flow, BOD, suspended solids, oil and grease, pH, temperature, bacteria, and priority pollutants. Effluent monitoring includes: flow, BOD, suspended solids, oil and grease, pH, temperature, bacteria, total residual chlorine, priority pollutants, and WET using the test organism *Tripneustes gratilla*. Receiving water quality monitoring includes: bacteria, visual observations, temperature, DO, salinity, pH, oil and grease, light extinction coefficient, and turbidity. Additionally, nutrients must be monitored in the offshore receiving waters. The receiving water quality monitoring program described in the permit requires a program to document water quality at the outfall, at areas near the ZID boundary, at areas beyond the ZID where discharge impacts might reasonably be expected, and at reference/control areas. The permit requires water quality monitoring to be conducted at stations along the shoreline and offshore at regular frequencies.

The current monitoring program was developed jointly by the applicant, HDOH, and EPA for the 1991 permit. The application contains no requests for specific modifications to the present monitoring program, but it does list general recommendations based on findings of the CCH's Division of Environmental Quality, local experts, and conclusions

of the Mamala Bay Commission. The application indicates that these may include: more frequent monitoring of sediments, refinement of analytical techniques, implementation of a mussel-watch program, elimination of benthic biological monitoring, and more frequent monitoring of nonpoint sources. Other than a summary of personnel, which demonstrates that CCH has the resources to implement and carry out the monitoring program, the application contains no other information on the monitoring program.

While EPA may have concluded at the time the existing permit was issued that the monitoring program was adequate, EPA has reanalyzed the monitoring program in light of the monitoring data that were collected during the course of the permit and in response to new water quality standards.

EPA's review has determined that the current monitoring program is not sufficient. As EPA is tentatively denying the variance application, EPA is not identifying the specific changes that would be necessary to the monitoring program. If EPA issues a final decision to deny the variance, HDOH would become the permitting authority for a secondary permit. In that case, EPA would offer to work with HDOH on the development of an appropriate monitoring program.

E. Impact of Modified Discharge on Other Point and Non-point Sources

Under 40 CFR 125.64, which implements section 301(h)(4), the applicant's proposed modified discharge must not result in the imposition of additional pollution control requirements on any other point or nonpoint source.

Two other wastewater treatment facilities discharge into Mamala Bay. The Sand Island outfall is located about 12 km to the east, and the Fort Kamehameha outfall is located about 5 km to the northeast of the Honouliuli diffuser. Cates International, an offshore fish farm, was operating in the vicinity of the outfall, but is no longer in operation and did not reapply for a new NPDES permit when the previous permit expired in June 2006. EPA is not aware of any additional requirements that have been imposed on these or other sources as a result of the applicant's discharge.

The application did not contain documentation from the HDOH that the Honouliuli discharge will not result in any additional treatment, pollution control, or other requirements on any other point or nonpoint source discharge, as set forth in 125.64(b). Likewise, the application does not contain a letter from the applicant to HDOH requesting this determination. As discussed in Section G of this document, however, because this tentative decision is that a modified permit not be issued, no State determination is necessary at this time.

F. Toxics Control

In accordance with 40 CFR 125.66, the applicant must design a toxics control program to identify and ensure control of toxic pollutants and pesticides discharged in the effluent. This program must address both industrial and nonindustrial source control. The control

of industrial sources is also addressed by the pretreatment program regulations [40 CFR 403.8(d)] and by 40 CFR 125.65, which are discussed in Section G of this document. The HWWTP Toxics Control Program is discussed in Appendix H of the application.

1. Chemical Analysis

Under 40 CFR 125.66(a), the applicant must submit at the time of application, a chemical analysis of its current discharge for all toxic pollutants and pesticides as defined in 125.58(aa) and (p). The analysis must be performed on two 24-hour composite samples (one in dry weather and one in wet weather).

In section III-H of the application, CCH provided a list of all toxic pollutants and pesticides detected in the influent from 1991 through December 2003.

As discussed in section C.1.b. of this document, the application contains a review of toxic pollutant and pesticide monitoring data from 1991 through 2003. The applicant also submitted, separate from the application, priority toxic pollutant and pesticide data from sampling conducted in 2004 and 2005.

Detected priority pollutants and pesticides, from sampling conducted in 2003 (wet season), 2004 (dry season), and 2005 (wet season), are listed below:

Antimony	Chloroform
Arsenic	Toluene
Beryllium	Benzene
Cadmium	Acrolein
Chromium	Diethyl phthalate
Copper	Methylene chloride
Lead	1,2-Dichlorobenzene
Mercury	Phenol
Nickel	Bis(2-ethylhexyl) phthalate
Selenium	Chlordane
Silver	Dieldrin
Zinc	Heptachlor epoxide

Based on this information, EPA has concluded that the applicant has met the requirement of 40 CFR 125.66(a)

2. Toxic Pollutant Source Identification

Under 40 CFR 125.66(b), the applicant must submit at the time of application an analysis of the known or suspected sources of toxic pollutants or pesticides identified in response to 40 CFR 125.66(a). To the extent practicable, the applicant must categorize the sources according to industrial and non-industrial types.

In the application, the applicant analyzed the concentrations of certain toxic pollutants but did not address the sources of these pollutants, saying only that one category of toxic pollutants, pesticides, is very difficult to control because of their persistence in the environment. Additionally, the applicant did not categorize the sources according to industrial and non-industrial types. Therefore, EPA has concluded that the applicant has not met the requirements of 40 CFR 125.66(b)

3. Industrial Pretreatment Requirements

Under 40 CFR 125.66(c), an applicant for a 301(h) variance that has known or suspected industrial sources of toxic pollutants must have an approved pretreatment program as described in 40 CFR 403. This requirement applies to CCH for its Honouliuli application given the presence of industrial sources of toxic pollutants. The applicant's industrial pretreatment program was approved by EPA on July 29, 1982. This approved program remains in effect. General details of the CCH Pretreatment program, such as staffing inspection, monitoring and enforcement, are outlined in Appendix H of the application. Specific details of the program are contained in the Pretreatment Program Annual Status Reports and quarterly reports.

On October 29, 2001, CCH submitted the Urban Area Pretreatment Program Local Limits Development – Final Report (Report), for approval by EPA and the HDOH. The Report updated the applicant's industrial pretreatment program in consideration of the influent load from Industrial Users (IUs). The Report discusses industrial sources of toxic pollutants which are served by the Honouliuli facility, thus confirming that the requirements of 40 CFR 125.66(c) apply. On May 16, 2005, EPA provided the results of its review of the Report (Kemmerer, 16 May 2005 letter). EPA concurred with the Report's conclusions regarding changes to limits for specified constituents, including heavy metals. However, EPA's May 16, 2005 letter also stated that the Report needed to be revised, specifically related to CCH's control of Fats, Oils, and Grease (FOG) in the CCH collection system. EPA's conclusion was that improved management of FOG is necessary to reduce the number of collection system spills due to FOG blockage. On November 9, 2005, HDOH concurred with EPA's May 16, 2005 letter. CCH has not yet made the revisions to its program regarding FOG, and in its most recent quarterly report (January 2007) indicated it was still studying the issue.

Although EPA has concerns regarding the need for improved management of FOG to avoid future sewage spills from the collection system, EPA has concluded that because an approved pretreatment program is in effect, CCH is complying with the Industrial Pretreatment Requirements of 40 CFR 125.66(c).

4. Nonindustrial Source Control Program

Under 40 CFR 125.66(d), the applicant must submit a proposed public education program designed to minimize the entrance of nonindustrial toxic pollutants and pesticides into the treatment facility.

The application indicates that CCH participates in educational efforts such as environmental displays at public events. At these events, the applicant distributes brochures and other materials containing information about CCH's environmental programs.

CCH also educates the public on the reduction of non-industrial pollutants by use of videos, handouts, newspaper articles, television stories, radio coverage, bus posters, and public service announcements. For example, CCH developed a video to educate the public on the proper disposal of fats, oil, and grease. On a quarterly basis, CCH advertises and conducts a Household Hazardous Waste Collection Program to accept and process chemical pesticides, herbicides, cleaning products and other potentially hazardous products for proper disposal.

Therefore, EPA concludes that the applicant's public education efforts meet the requirements of 40 CFR 122.66(d).

G. Urban Area Pretreatment Program

Under 40 CFR 125.65, large applicants for a modified NPDES permit under section 301(h) of the Act that receive one or more toxic pollutants from an industrial source are required to comply with the urban area pretreatment requirements. Large applicants are defined in 40 CFR 125.65 as those which serve a population of 50,000 or more. These requirements therefore apply to CCH's application for the Honouliuli WWTP. A POTW subject to these requirements must demonstrate toxic pollutant control. CCH has chosen to demonstrate this control by developing and implementing the Applicable Pretreatment Requirement, as discussed in 40 CFR 125.65(c).

As discussed with regard to 40 CFR 125.66(c), the applicant's industrial pretreatment program was approved by EPA on July 29, 1982, and EPA consider the applicant has met the requirement to have an approved pretreatment program under CWA 403. Thus, CCH meets the requirements of 40 CFR 125.65(b)(1). However, 40 CFR 125.65(b)(2) requires that the applicant demonstrate that industrial sources are in compliance with all applicable pretreatment requirements, and that the applicant will enforce those requirements. EPA has concluded that CCH has not met those criteria. CCH's most recent quarterly pretreatment reports covering calendar year 2006 indicate that there are currently only two significant industrial users (SIUs) in the Honouliuli service area. The reports indicate that for one of those two users, CCH has been evaluating the user's status as an SIU at least since the first quarter 2006, and has still not come to a conclusion. With regard to the other SIU, the report indicates that even though CCH indicates there were violations of pretreatment requirements from August 2005 through May 2006, CCH

did not issue a notice of violation to the user until November 29, 2006. EPA records also indicate that the original violation was found by an EPA inspector, not CCH. Thus, we cannot conclude at this time that the applicant has demonstrated that industrial sources are in compliance with all applicable pretreatment requirements, and that the applicant will enforce those requirements, as required by 40 CFR 125.65(b)(2).

We note that the requirements in 40 CFR 125.65(b) are in a section entitled "toxic pollutant control," and that the parameter for which CCH delayed 15 months in issuing the notice of violation was pH, which is not a toxic pollutant. However, the specific language of 40 CFR 125.65(b)(2) does not limit the requirement to toxic pollutants. Moreover, the Act at Sec. 301(h)(5) specifically requires that "all applicable pretreatment requirements for sources introducing waste into such treatment works will be enforced." This statutory requirement is not limited to toxic pollutants. Thus, EPA finds that the applicant has not demonstrated that it will enforce pretreatment requirements, despite the fact that the problems in its enforcement do not relate to a toxic pollutant.

H. Increase in Effluent Volume or Amount of Pollutants Discharged

Under 40 CFR 125.67, which implements section 301(h)(8), the applicant's discharge of the pollutants to which the modification applies may not increase above the amount specified in the 301(h)-modified NPDES permit.

Table 26 presents the applicant's projections for annual average flow and effluent concentrations and mass loadings of BOD_5 and TSS in five-year increments (1995 - 2020). Effluent loads are estimated based on existing permit limits, population projections and per capita per day factors contained in CCH's master plan. Based on the projected increase in influent BOD_5 concentrations, the applicant is requesting an increase in the effluent BOD_5 limitation. Using the maximum monthly average influent BOD_5 concentration of 283 mg/l from 1994, the applicant calculated the maximum effluent BOD_5 concentration under primary treatment requirements (30 percent removal) will be 198 mg/l. As a result, the applicant requested a BOD_5 limitation of 200 mg/l.

The current design flow of the plant is 38 MGD. The solids handling facility is designed to process influent flow of up to 29 MGD. Planned upgrades to the solids treatment facility, which were discussed in the application and scheduled to be completed in 2006, have not yet been initiated. Otherwise, there is no construction planned to improve the primary treatment facility. It should be noted that the annual average flow for 2005 was estimated to be 34 MGD but was actually only 25.8 MGD. The maximum daily flow for the year was only 29.2 MGD.

Therefore, it is questionable whether the requested increased effluent limit for BOD_5 is appropriate. The applicant has not proved that it can discharge effluent with a BOD_5 concentration of 200 mg/L and still achieve 30% removal.

I. Compliance with Other Applicable Laws

1. State Coastal Zone Management Program

Under 40 CFR 125.59(b)(3), a 301(h)-modified NPDES must comply with the Coastal Zone Management Act, 16 USC 1451 *et seq* . In accordance with 16 USC 1456(c)(3)(A), a 301(h)-modified permit may not be issued unless the proposed discharge is certified by the State to comply with applicable State coastal zone management program(s) approved under the Coastal Zone Management Act, or the State waives such certification.

On December 24, 1997, the State of Hawaii's Office of State Planning wrote that it concurred with CCH's determination (apparently on its 1995 application) that the discharge was consistent with the provisions of the Hawaii Coastal Zone Management Program, with the condition that State water quality standards and requirements of the Department of Health were complied with (Egged, 24 December 1997 letter). In the current application, the applicant indicates that a response letter from the Office of State Planning is pending; however, this letter has not been submitted to EPA. The applicant supplied no indication of why the letter was not submitted, nor is EPA aware that the Office of State Planning has reviewed the current application. Therefore, the applicant has not complied with this regulation.

2. Marine Sanctuaries

40 CFR 125.59(b)(3) provides that issuance of a modified NPDES permit must comply with Title III of the Marine Protection, Research and Sanctuaries Act, 16 USC 1431 *et seq*.. In accordance with 16 USC 1432(f)(2), a 301(h)-modified NPDES permit may not be issued for a discharge located in a marine sanctuary designated pursuant to Title III if the regulations applicable to the sanctuary prohibit issuance of such a permit.

The application indicates that the HWWTP outfall is not located in an estuary or marine sanctuary. The applicant indicated that an update letter was sent to the U.S. National Marine Fisheries Service to verify this fact, along with an update letter to the National Ocean Service (NOS) regarding the sanctuary boundary determination. The applicant implied that a copy of the letter was placed in Appendix E of the application, but no letter is present in Appendix E. Furthermore, the application states that a response from the NOS is pending. However, this response, if available, has not been submitted to EPA. Therefore, the applicant has not demonstrated that the discharge is in accordance with this regulation. It would seem possible that the discharge would not be restricted by regulations protecting the Hawaiian Islands Humpback Whale National Marine Sanctuary designation, which has specified boundaries around Maui but does not include the island of Oahu, but the applicant has not provided the appropriate correspondence to clarify this point.

3. Endangered or Threatened Species

40 CFR 125.59(b)(3) provides that issuance of a 301(h)-modified NPDES permit must comply with the Endangered Species Act (ESA), 16 USC 1531 *et seq*. In accordance with 16 USC 1536(a)(2), a 301(h)-modified NPDES permit may not be issued if the

proposed discharge will adversely impact threatened or endangered species or critical habitat listed pursuant to the Endangered Species Act.

The applicant filed letters with NOAA's National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) to determine conformance with the Endangered Species Act. NMFS identified four listed species: the threatened green turtle (*Chelonia mydas*) and the endangered humpback whale (*Megaptera novaeangliae*), hawksbill turtle (*Eretmochelys imbricata*) and Hawaiian monk seal (*Monachus schauinslandia*) that could be found in the vicinity of the outfall. The applicant did not provide evidence that either USFWS or NMFS has made recommendations with regard to the current application as to whether the applicant's discharge will comply with the ESA. Therefore, the applicant has not provided written documentation that the 301(h)-modified permit will comply with the ESA.

Although EPA's files include a letter from the USFWS (Harper, 26 November 1997 letter), and one from the NMFS (Hogarth, 13 January 1998 letter), concluding, at that time, that the applicant's discharge was not likely to adversely affect listed species, those letters did not consider the more recent 2004 application, nor can they be considered up to date. For example, the 1998 NMFS letter does not include all the species mentioned in the more recent NMFS identification mentioned above.

Based on the lack of documentation provided by the applicant, EPA concludes that the applicant has not met the requirement contained in 401 CFR 125.59(b)(3) to demonstrate that the discharge will not conflict with the provisions of State, local, or other Federal laws.

J. State Determinations and Concurrence

On January 20, 1998, the Hawaii Department of Health stated (Anderson, 20 January 1998 letter) that "there is a reasonable assurance that the discharge will comply with applicable provisions of State law including water quality standards and will not result in any additional treatment pollution control, or other requirements on any other point or nonpoint source." HDOH also wrote, "the decision to grant a Section 301(h) waiver, by the U.S. EPA Regional Administrator, requires a final State concurrence. Therefore, the State retains the right to approve or deny the issuance of the final permit." No more current correspondence on this issue has been submitted.

Although the State concluded in 1998 that the discharge apparently would comply with water quality standards, this conclusion did not address the 2004 application and was reached prior to the promulgation of the new bacteria standards described above, and prior to EPA's comprehensive analysis, based primarily on post-1998 data, of the applicant's discharges with regard to toxics, whole effluent toxicity, and nutrient standards.

If EPA's tentative decision had recommended approval of the 301(h) variance and issuance of a modified permit, State concurrence would be necessary prior to issuance of

such a permit. Here, as the tentative decision determines that a modified permit would not be appropriate, no modified permit has been prepared. Because this tentative decision is that a modified NPDES permit not be issued, no State concurrence or determination is necessary at this time.

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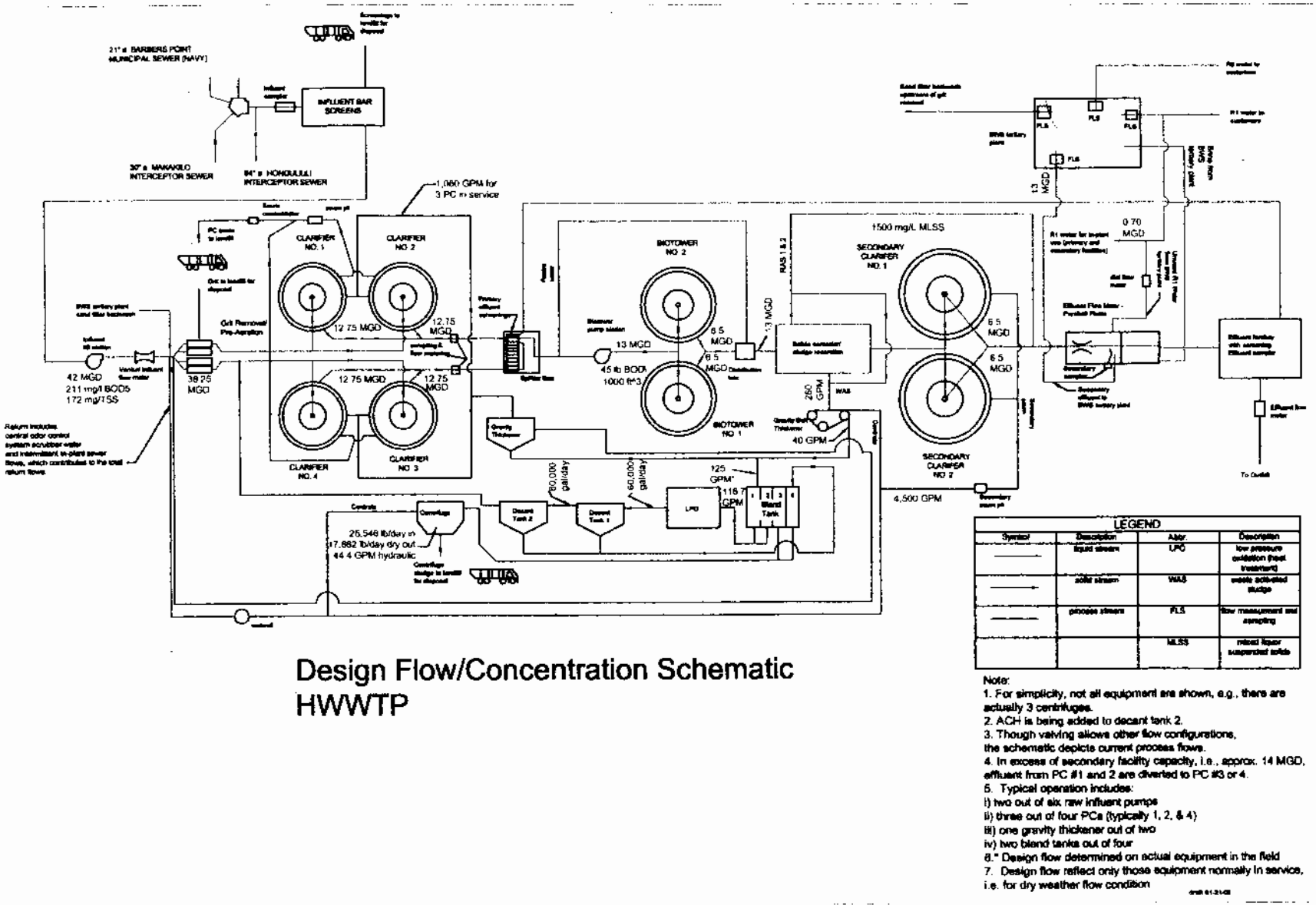

Figure 1 Facility layout (Attachment 3 from Takamura 21 January 2005 letter)

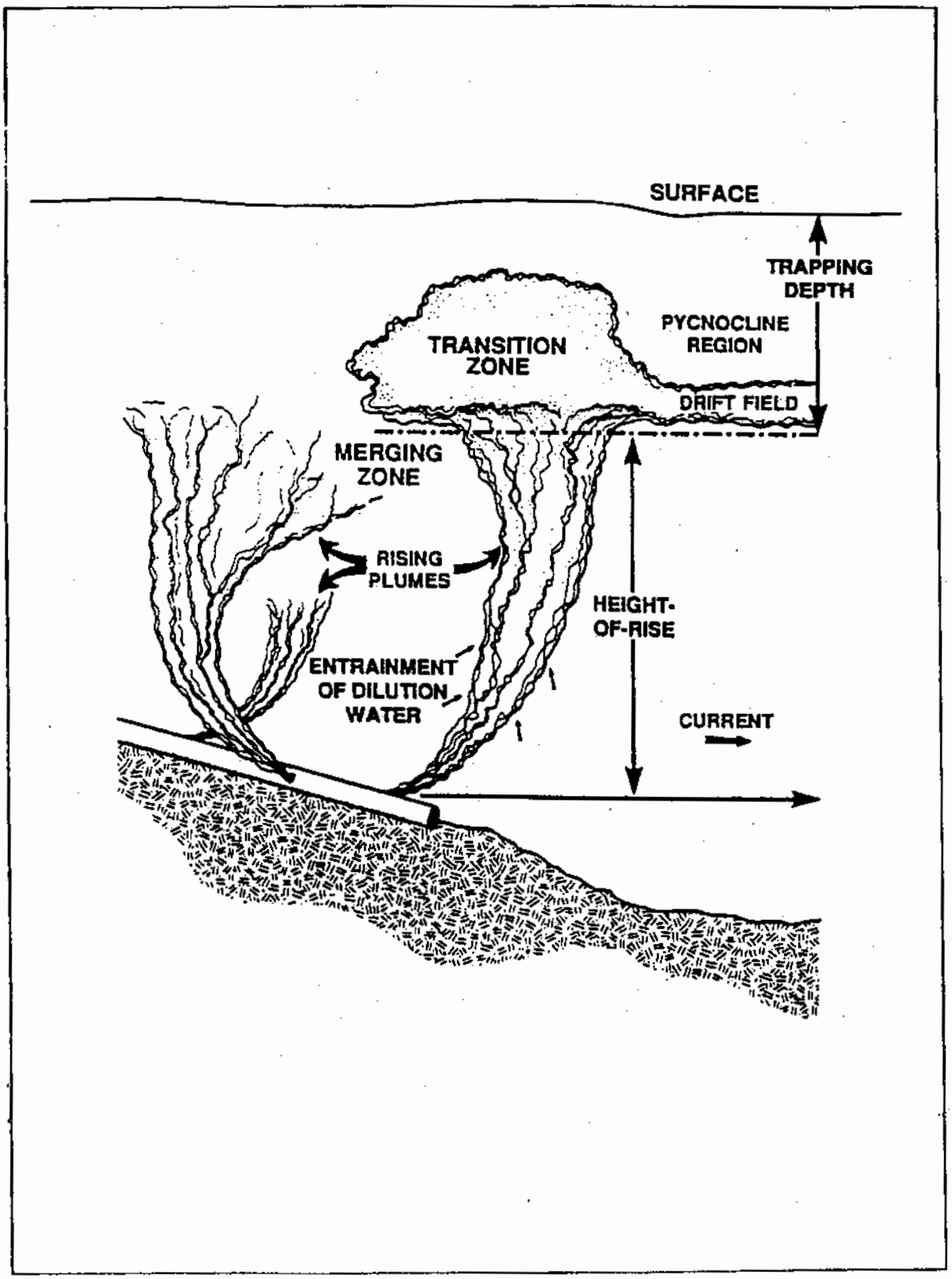

Figure 2 Wastefield generated by a simple ocean outfall (ATSD 1994)

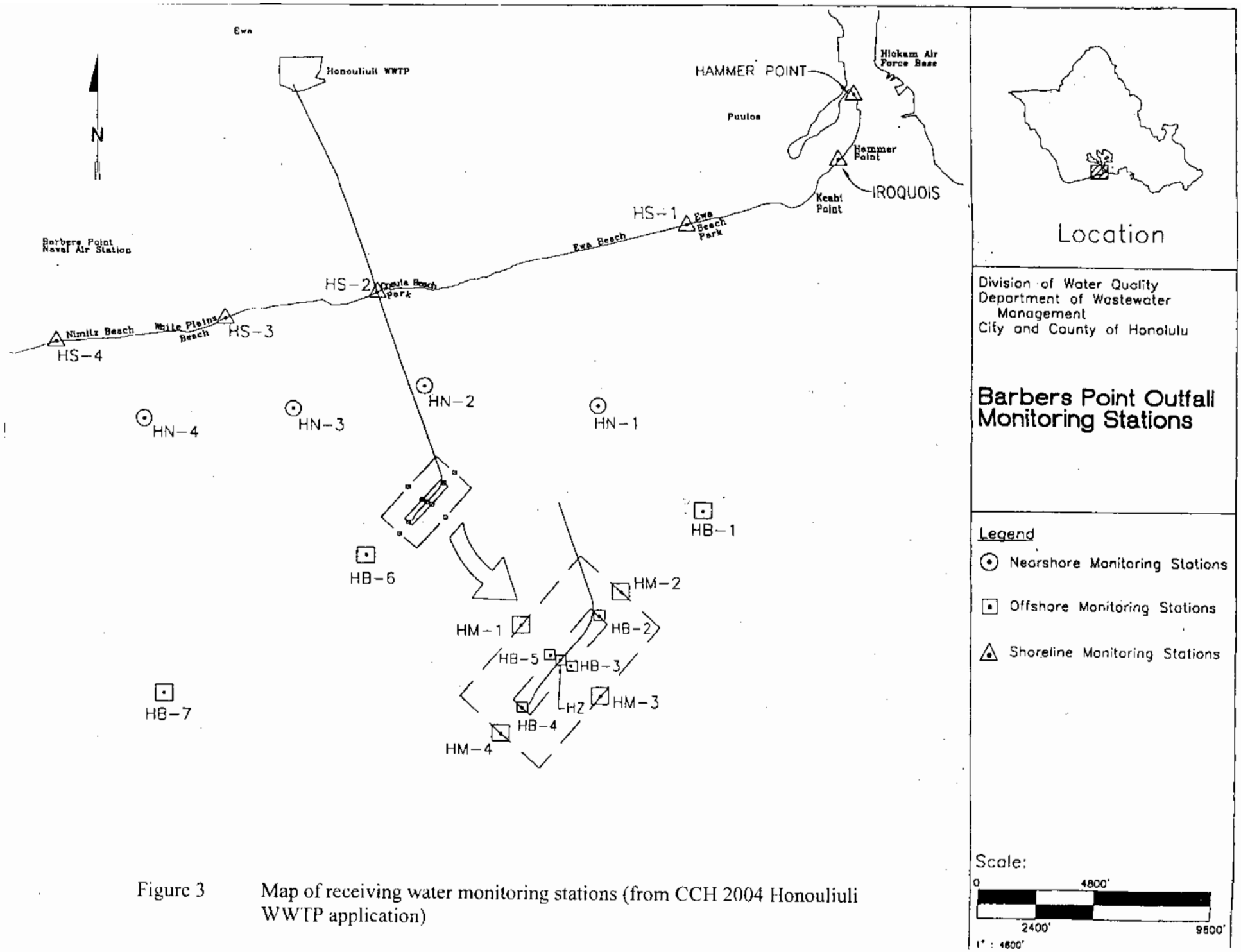

Figure 3 Map of receiving water monitoring stations (from CCH 2004 Honouliuli WWTP application)

Table 1. Physical Characteristics of the Honouliuli Outfall and Diffuser

Description	**Value**
Outfall diameter from WWTP to shore, m (in)	2.13 (84)
Outfall Diameter from shore to diffuser, m (in)	1.98 (78)
Outfall length from WWTP to shore, m (ft)	2,794 (9,167)
Outfall length from shore to the diffuser, m (ft)	2,670 (8,760)
Diffuser diameter, m (ft)	
Section 1	1.98 (6.5)
Section 2	1.67 (5.5)
Section 3	1.22 (4.0)
Diffuser length, m(ft)	538 (1,765)
Angle of port orientation from horizontal, degrees	0
Port diameter, cm (in)	
42 ports	8.7 (3.41)
50 ports	9.1 (3.58)
54 ports	9.5 (3.74)
2 ports	15.2 (6)
Discharge coefficient	
42 ports	0.948 – 0.959
50 ports	0.944 – 0.964
54 ports	0.938 – 0.975
2 ports	0.975
Vertical distance from mean lower low water (MLLW) to port, m (ft)	60.96 (200)
Number of ports	148
Port spacing, m (ft)	7.315 (24)
Design maximum hydraulic rate for each port, m^3/sec (MGD)	0.033 (0.75)

Design maximum hydraulic rate for each port based on design capacity of 112 MGD.

Table 2. Proposed and current effluent Limits for BOD and TSS.

Parameter	Proposed Limits		Current Limits		Current Performance* (range of monthly averages)
	30-day average	7-day average	30-day average	7-day average	
BOD	200 mg/l	240 mg/l	160 mg/l	240 mg/l	73 – 192 mg/l
TSS	95 mg/l	142 mg/l	95 mg/l	142 mg/l	29 – 134 mg/l

* Based on discharge monitoring reports submitted by the applicant from June 1991 through December 2006, excluding the period from July 2000 through November 2003 when certified data were not reported.

Table 4. Projected effluent flow rates.

	Year		
	2010	2015	2020
Average Dry Weather	33.45 MGD	35.11 MGD	36.75 MGD
Average Wet Weather	39.46 MGD	41.62 MGD	43.79 MGD
Annual Average	36.14 MGD	38.16 MGD	39.99 MGD

Table 3. Honouliuli WWTP flow scenarios (from Attachment A.1 of Takamura 15 April 2005 letter)

ATTACHMENT A.1: DISCHARGE FLOW SCENARIOS

Operating Configuration	1	2	3	4	5	6
Primary	Entire influent treated to primary and discharged through the outfall. Average dry weather design flow: 38 MGD	Influent flow minus secondary treated effluent flow, treated to the primary level and discharged to the outfall	Influent flow minus secondary treated effluent flow, treated to the primary level and discharged to the outfall	Influent flow minus secondary treated effluent flow, treated to the primary level and discharged to the outfall	Influent flow minus secondary treated effluent flow, treated to the primary level and discharged to the outfall	Influent flow minus secondary treated effluent flow, treated to the primary level and discharged to the outfall
Secondary	No secondary treated effluent waste stream discharged to the outfall	Up to the maximum capacity of 16 MGD of secondary treated effluent discharged to the outfall	Minimum secondary treated effluent discharged to the outfall. 13 MGD of secondary wastewater available to the reclamation facility	Minimum secondary treated effluent discharged to the outfall. 13 MGD of secondary wastewater available to the reclamation facility	Minimum secondary treated effluent discharged to the outfall. Flows available to the secondary facility will range from approximately 5 to 13 MGD.	Minimum secondary treated effluent discharged to the outfall. 13 MGD or less is available to the reclamation facility
R-1	No R-1 quality effluent discharged to the outfall	No R-1 quality effluent discharged to the outfall	10 MGD of R-1 water is being produced. For the remaining R-1 water not demanded by offsite users, it will be piped to HWWTP for in-plant use and/or for recharge to ground water via the trench. Any unused R-1 water will be discharged to the outfall.	10 MGD of R-1 water is being produced. For the remaining R-1 water not demanded by offsite users, it will be piped to HWWTP for in-plant use and/or for recharge to ground water via the trench. Any unused R-1 water will be discharged to the outfall..	No R-1 water is being produced	10 MGD or less of R-1 water to users, which could be a combination of in-plant reuse (i.e., at the HWWTP), offsite use (e.g. golf courses) and the trench at the HWWTP. Any unused R-1 water will be discharged to the outfall.
R-0	No R-0 effluent discharge to the outfall.	No R-0 effluent discharge to the outfall.	2 MGD of R-0 water by design to consumers.	No R-0 water is being produced (no users)	2 MGD of R0 water by design to consumers	2 MGD or less of R-0 water design to consumers
Brine	No brine discharge discharged to the outfall	No brine discharged to the outfall	Up to 925 gpm by design to the outfall (stated in the preliminary engineering report)	No brine is produced	Up to 925 gpm by design to the outfall (as stated in the preliminary engineering report)	925 gpm of flow by design or less to the outfall
Sand Filter Return Backwash	No filter back wash discharged to the HWWTP preaeration chamber.	No filter back wash discharged to the HWWTP preaeration chamber.	Max flow of 1,100 gpm (limited by the filter backwash pump station by design) to the HWWTP preaeration tank	1,100 gpm or less to the HWWTP preaeration tank.	1,100 gpm or less to the HWWTP preaeration tank.	1,100 gpm or less to the HWWTP preaeration tank.

Table 5. Summary of monthly TSS and BOD removal rates from June 1991 through December 2006.

TSS Removal Rates (% removal)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
January		82	71	77	78	77		93	85	87				86	86	85
February		80	73	75	77	77	92	92	87	87				83	86	86
March		80	70	75	66	83	91	92	86	90				89	84	85
April		80	77	73	81	83	92	93	86	88				87	85	84
May		73	79	72	83	80	90	89	87	86				86	85	83
June	81	78	81	76	78	77	89	90	85	84				84	84	84
July	78	73	82	68	76	77	90	95	84	85				83	81	84
August	84	75	78	71	79	81		88	87	92				83	70	53
September	79	76	78	78	76	81	90	89	88	86				83	81	86
October	79	76	76	74	75	90	91	88	88	84				82	85	86
November	78	72	75	83	75	85	92	87	87				84	85	88	85
December	80	74	80	78	76	92	92	84	85				88	84	86	88
Annual Average	**80**	**77**	**77**	**75**	**77**	**82**	**91**	**90**	**86**					**85**	**83**	**82**

BOD Removal Rates (% removal)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
January		55	39	32	33	41		69	59	55				51	55	53
February		47	39	36	36	42	72	73	61	55				47	52	54
March		48	38	33	31	48	70	74	58	63				59	51	54
April		45	49	32	43	43	71	76	53	58				52	55	53
May		40	43	27	43	47	66	70	53	56				49	53	53
June	52	40	48	29	40	42	66	67	85	54				48	50	50
July	50	36	46	29	44	44	69	68	55	53				49	47	50
August	60	42	44	25	45	44		51	58	70				49	45	32
September	51	40	48		45	45	63	58	62	62				48	51	51
October	52	45	40	35	40	62	62	59	56	59				47	52	48
November	49	41	38	48	43	53	63	57	53				49	55	60	46
December	53	43	35	35	42		63	54	54				56	55	57	55
Annual Average	**52**	**44**	**42**	**33**	**40**	**46**	**67**	**65**	**59**	**59**			**53**	**51**	**52**	**50**

Table 6. HWTTP TSS data from primary channels (May 15 to August 15, 2005).

	Total Influent Flow (MGD)	Effluent Flow (MGD)		Total Influent TSS (mg/L)	Effluent TSS (mg/L)		Average Percent Removal		Combined Average Percent Removal
		PC1	**PC2**		**PC1**	**PC2**	**PC1**	**PC2**	**PC1+PC2**
May 15-31	26.9	20.8	10.5	322.4	53.9	59.7	81.8 %	79.8 %	80.8 %
June 1-30	26.9	20.9	9.8	362.9	49.6	57.1	84.7 %	82.3 %	83.5 %
July 1-31	27.6	20.5	9.4	274.0	54.6	55.2	79.4 %	79.2 %	79.3 %
August 1-15	27.8	21.6	9.5	318.8	57.2	55.8	81.8%	82.2 %	82.0 %
Overall Average	27.3	21.0	9.8	319.5	53.8	56.9	81.9%	80.9 %	81.4 %

Table 7. HWTTP BOD data from primary channels (May 15 to August 15, 2005).

	Total Influent Flow (MGD)	Effluent Flow (MGD)		Total Influent BOD (mg/L)	Effluent BOD (mg/L)		Average Percent Removal		Combined Average Percent Removal
		PC1	**PC2**		**PC1**	**PC2**	**PC1**	**PC2**	**PC1+PC2**
May 15-31	26.9	20.8	10.5	303.1	162.1	216.7	45.1 %	26.5 %	35.8 %
June 1-30	26.9	20.9	9.8	298.3	154.1	213.2	47.4 %	27.3 %	37.3 %
July 1-31	27.6	20.5	9.4	283.5	161.0	210.4	42.4 %	24.5 %	33.5 %
August 1-15	27.8	21.6	9.5	285.1	155.5	196.7	45.7 %	31.3 %	38.5 %
Overall Average	27.3	21.0	9.8	292.5	158.2	209.2	45.2 %	27.4 %	36.3 %

Table 8: Single sample exceedances of 104 cfu enterococcus concentration at Honouliuli nearshore monitoring stations, 1991-2006

Year	Sample events per year[1]	Samples per year at each depth	Number of **surface** samples above 104 cfu	Stations	Number of **bottom** samples above 104 cfu	Stations[2]
1991	31	124	1	HN1	0	
1992	61	244	0		0	
1993	38	152	5	HN2, HN3, HN4	4	HN1, HN2, HN3, HN4
1994	63	252	3	HN1, HN3, HN4	4	HN1, HN4
1995	61	244	0	HN4	1	
1996	61	244	1	HN2	3	HN1, N2, HN3
1997	61	244	5	HN2, HN3	8	HN1, HN2, HN3, HN4
1998	61	244	1	HN4	2	HN2, HN4
1999	61	244	1	HN2	6	HN2, HN3, HN4
2000	61	244	1	HN2	1	HN2
2001	61	244	5	HN2,HN3, HN4	2	HN1, HN4
2002	61	244	0		0	
2003	35	140	0		0	
2004	61	244	0		3	HN1, HN2, HN3
2005	61	244	0		1	HN4
2006	62	248	1	HN1	7	HN2, HN3, HN4
Total	**900**	**3600**	**24**		**42**	

[1] All samples taken beyond 1000 feet from shore, on a weekly basis, at nearshore monitoring stations HN1, HN2, HN3, and HN4.

[2] Bottom samples taken at 11m (36 ft depth).

Table 9. Exceedances of enterococcus geometric mean (35 cfu/100ml) in monthly samples at Honouliuli offshore monitoring stations, 2005 and 2006:

Year	Number of monitoring events at each site[1]	Number of samples at each depth	Geometric mean exceedances at surface	Monitoring Station	Geometric mean exceedances at bottom (57-70 m; 187-230 ft)	Monitoring Station	Geometric mean exceedances of all samples at station	Monitoring Station
2005	4	36	1	HB5	19	HB2, HB3, HB4, HB5, HB6, HM1,HM2,HM4	6	HB4, HB5, HM1,HM4
2006	4	36	4	HB3, HM3	30	HB2,HB3, HB4, HB5, HB6, HM1,HM2, HM3,HM4	11	HB2,HB3, HB4, HB5 HM1,HM2, HM3,HM4
Total	**8**	**72**	**5**		**49**		**17**	

[1] Offshore samples taken at the following monitoring stations:

- Edge of zone of initial dilution: HB2, HB3, HB4, HB5
- Edge of zone of mixing: HM1, HM2, HM3, HM4
- Beyond southwest corner of zone of mixing: HB6

Table 10. Exceedances of enterococcus single sample maximum value (501 cfu/100) at Honouliuli offshore monitoring stations, 2005 - 2006

Year	Number of sample events at each monitoring stations[1]	Samples per year at each depth	Number of Exceedances		Bottom Station with Exceedance
			Surface	Bottom (57-70 m; 134-230 ft)	
2005	4	36	0	8	HB3, HB5, HB6, HM1, HM4
2006	4	36	0	9	HB2, HB3, HB4, HB5, HM1
Total	**8**	**72**	**0**	**17**	

Table 11: Single samples above 104 cfu enterococcus concentration at surface and bottom of Honouliuli offshore monitoring stations, 2005-2006

Year	Number of sample events at each monitoring stations[1]	Samples per year at each depth	Number of **surface** samples above 104	Stations	Number of **bottom** samples above 104	Stations
2005	4	36	1	HB5	12	HB1, HB3, HB4, HB5, HB6, HM1, HM4
2006	4	36	1	HM3	18	HB2,HB3, HB4, HB5, HB6, HM1, HM2, HM3, HM4
Total	**8**	**72**	**2**		**30**	

[1] Offshore samples taken at the following monitoring stations:

- Edge of zone of initial dilution: HB2, HB3, HB4, HB5
- Edge of zone of mixing: HM1, HM2, HM3, HM4
- Beyond southwest corner of zone of mixing: HB6

Table 12. Exceedances of geometric mean (35cfu/100ml) in monthly samples taken at Honouliuli offshore monitoring stations[1], November 2003 - November 2004:

Sample date	Number of GM exceedances at **surface** [2]	Site	Number of GM exceedances at **middle depth** [2] (20-35 m; 66-115 ft)	Site	Number of GM exceedances at **bottom depth** [2] (41-70 m; 134-230 ft)	Site	Exceedance of GM using all 3 samples at site to form GM	Site
11/25/03	0 / 9		1 / 9	HM1	5 / 9	HB3, HB4, HB5, HB6, HM1	1	HM1
12/7/03	0 / 9		4 / 9	HB2, HM1, HM2, HM4	2 / 9	HB5, HM1	1	HM1
1/6/04	0 / 9		8 / 9	HB2, HB3, HB4, HB5, HB6, HM1, HM2, HM4	9 / 9	HB2, HB3, HB4, HB5,HB6 HM1, HM2, HM3, HM4	4	HB4, HB5, HB6, HM4
2/11/04	0 / 9		5 / 9	HB2, HB3, HB5, HM1, HM2	9 / 9	HB2, HB3, HB4, HB5,HB6 HM1, HM2, HM3, HM4	0	
3/12/04	0 / 9		3 / 9	HB6, HM3, HM4	4 / 9	HB3, HB4, HB6, HM4	0	
4/5/04	0 / 9		7 / 9	HB2, HB3, HB4, HB5 HM2, HM3, HM4	3 / 9	HB4, HM2, HM4	2	HB4, HM4
5/5/04	0 / 9		1 / 9	HM1	2 / 9	HB5 HM1	1	HM1
6/4/04	0 / 9		1 / 9	HM1	5 / 9	HB4, HB5, HB6, HM1,HM4	1	HM1
7/22/04	0 / 9		0 / 9		7 / 9	HB2, HB3, HB4, HB5 HM1, HM3, HM4	2	HB4, HM3
8/3/04	2 / 9	HB6, HM1	3 / 9	HB6 HM1, HM3	5 / 9	HB4, HB5, HB6, HM3, HM4	2	HB6, HM1
9/14/04	2 / 9	HB6, HM4	2 / 9	HB6, HM4	8 / 9	HB2, HB4, HB5, HB6 HM1, HM2, HM3, HM4	6	HB4, HB5, HB6, HM1, HM3, HM4
10/20/04	3 / 9	HB3, HB5, HM1	3 / 9	HB3, HB5 HM1	4 / 9	HB4, HB5, HM1, HM2	4	HB3, HB4, HB5, HM1
11/1/04	0 / 9		4 / 9	HB2, HB3, HM1, HM2	8 / 9	HB2,HB3,HB4,HB5, HB6 HM1, HM2, HM4	3	HB2, HM1, HM2
Total	**7** / 117		**42** / 117		**71** / 117		**27** / 117	

[1] Offshore samples taken at the following monitoring stations:

- Edge of zone of initial dilution: HB2, HB3, HB4, HB5
- Edge of zone of mixing: HM1, HM2, HM3, HM4
- Beyond southwest corner of zone of mixing: HB6

[2] Criteria effective 12/04 applied to samples taken prior to 12/04

Table 13. Exceedances of single sample maximum value (501cfu/100ml) of monthly samples taken at Honouliuli offshore monitoring stations [1], November 2003 - November 2004.

Sample date	Number of SSM Exceedances at **Surface**	Site	Number of SSM Exceedances at **Middle Depth** (20-35 m; 66-115 ft)	Site	Number of SSM Exceedances at **Bottom Depth** (41-70 m; 134-230 ft)	Site
11/25/03	0		0		1	HB5
12/7/03	0		0		0	--
1/6/04	0		0		2	HB5, HM4
2/11/04	0		0		0	--
3/12/04	0		0		3	HB3, HB4, HM4
4/5/04	0		1	HB4	0	--
5/5/04	0		0		0	
6/4/04	0		0		1	HB5
7/22/04	1	HM3	0		2	HB4, HB5
8/3/04	0		0		2	HB5, HB6
9/14/04	0		0		4	HB2, HB5, HB6, HM3
10/20/04	0		0		0	
11/1/04	0		1	HB2	3	HB4, HB6, HM4
Total	1		**2**		**18**	

[1] Offshore samples taken at the following monitoring stations:

- Edge of zone of initial dilution: HB2, HB3, HB4, HB5
- Edge of zone of mixing: HM1, HM2, HM3, HM4
- Beyond southwest corner of zone of mixing: HB6

Table 14. Single sample exceedances of 104 cfu/100 ml enterococcus concentration in monthly samples at Honouliuli offshore monitoring stations[1], November 2003 – November 2004.

Sample date	Number of SSM Exceedances at **Surface**	Site	Number of SSM Exceedances at **Middle Depth** (20-35 m; 66-115 ft)	Site	Number of SSM Exceedances at **Bottom Depth** (41-70 m; 134-230 ft)	Site
11/25/03			1	HM1	1	HB5
12/7/03			1	HM1	1	HB5
1/6/04			4	HB3, HB4, HB6, HM4	5	HB2, HB4, HB5, HM2, HM4
2/11/04			2	HB5, HM2	1	HB4
3/12/04	1	HM3	0		3	HB3,HB4, HM4
4/5/04			3	HB4, HM2,HM4	2	HB4, HM4
5/5/04			1	HM1	2	HB5, HM1
6/4/04			1	HM1	2	HB5, HM1
7/22/04	1	HM3	1	HM1	3	HB3, HB4, HB5
8/3/04	2	HB6, HM1	2	HB6, HM1	4	HB4, HB5, HB6, HM4
9/14/04			1	HM1	6	HB2,HB4, HB5, HB6, HM3, HM4
10/20/04	1	HB5	1	HM1	2	HB5, HM1
11/1/04			3	HB2, HM1,HM2	5	HB3, HB4, HB5, HB6, HM4
Total	5		21		37	

[1] Offshore samples taken at the following monitoring stations:

- Edge of zone of initial dilution: HB2, HB3, HB4, HB5
- Edge of zone of mixing: HM1, HM2, HM3, HM4
- Beyond southwest corner of zone of mixing: HB6

Table 15. Exceedances of enterococcus geometric mean (35 cfu/100ml) in monthly samples taken at Honouliuli offshore monitoring stations from June 1991 - October 2003

Year	Number of monitoring events at each site[1]	Number of samples at each depth	Geometric mean exceedances at surface [2]	Monitoring Station	Geometric mean exceedances at bottom (57-70 m; 187-230 ft) [2]	Monitoring Station	Geometric mean exceedances of all samples at station [2]	Monitoring Station
1991	2	18	0		15	HB2,HB3,HB4,HB5, HB6, HM1, HM2, HM4	0	
1992	4	36	3	HB4, HB5, HM4	13	HB2, HB3, HB4, HB5, HB6, HM2, HM3, HM4	1	HM4
1993	4	36	0		15	HB4, HB5, HB6, HM1, HM2, HM3, HM4	0	
1994	4	36	1	HM2	27	HB2,HB3,HB4,HB5, HB6, HM1, HM2, HM3, HM4	5	HB5, HM2,HM3,HM4
1995	4	36	6	HB2,HB3,HB5, HM2,HM3,HM4	21	HB2, HB3, HB4, HB5, HB6, HM1,HM3,HM4	10	HB3,HB4,HB5, HB6,HM3,HM4
1996	4	36	8	HB3,HB4,HB5, HM1,HM3, HM4	22	HB2, HB3, HB4, HB5, HB6, HM1, HM2, HM3, HM4	8	HB3,HB4,HB5, HM1,HM3
1997	2	18	0		9	HB2,HB5, HM1,HM2,HM3,HM4	0	
1998	4	36	1	HM4	24	HB2,HB3,HB4,HB5, HB6,HM1,HM2,HM3,HM4	4	HB4, HB5, HM4
1999	4	36	9	HB2,HB3,HB4,HB5, HB6,HM1,HM4	23	HB2,HB3,HB4, HB5, HB6, HM1,HM2, HM3, HM4	11	HB2,HB3,HB4,HB5, HB6, HM1, HM4
2000	4	36	3	HB3, HB5, HM3	23	HB2,HB3,HB4,HB5 HB6, HM1,HM2,HM4	3	HB3, HB5, HM1
2001	4	36	6	HB4, HB6, HM4	19	HB2,HB3,HB4,HB5,HB6, HM1,HM2,HM3,HM4	7	HB2,HB4,HB5, HB6, HM4
2002	4	36	10	HB2,HB3,HB4, HB5, HM1, HM2	27	HB2, HB3, HB4, HB5,HB6, HM1, HM2, HM3, HM4	14	HB2, HB3, HB4, HB5, HB6, HM1, HM2, HM4
2003	5 Feb, Apr, Sept (2), Oct	45	8	HB2,HB3,HB4, HB5,HB6,HM1,HM4	23	HB2, HB3, HB4, HB5,HB6, HM1, HM2, HM3, HM4	11	HB2,HB3,HB4,HB5, HM1, HM4
Total	**49**	**441**	**55**		**261**		**74**	

[1] Offshore samples taken at the following monitoring stations:

- Edge of zone of initial dilution: HB2, HB3, HB4, HB5
- Edge of zone of mixing: HM1, HM2, HM3, HM4
- Beyond southwest corner of zone of mixing: HB6

[2] Criteria effective 12/04 applied to samples taken prior to 12/04

Table 16. Exceedances of enterococcus single sample maximum value (501 cfu/100) at the surface (S) and bottom (B) of Honouliuli offshore sites from June 1991 and October 2003.

Year	**Number of sample events at each site**[1]	**Total number of samples at each depth**	**Number of Exceedances**		**Station with Exceedance**
			Surface	Bottom (57-70 m; 134-230 ft)	
1991	2	18	0	5	B: HB2, HB4, HM1
1992	4	36	0	1	B: HB5
1993	4	36	0	0	
1994	4	36	0	5	B: HB2, HB4, HB5, HM4
1995	4	36	0	5	B: HB3, HB4, HB6, HM3
1996	4	36	0	1	B: HB3
1997	2	18	0	1	B: HB5
1998	4	36	0	3	B: HB5, HM1
1999	4	36		3	B: HB3, HB4, HB5
2000	4	36	0	4	B: HB3, HB4, HB5, HM1
2001	4	36	0	1	B: HB5
2002	4	36	1	9	S: HB5 B: HB2, HB3, HB4, HB5, HB6, HM4
2003	5	54	3	7	S: HB3, HB5, HM3 B: HB5, HM2, HM3, HM4
Total	**49**	**441**	**4**	**45**	

[1] Offshore samples taken at the following monitoring stations:

- Edge of zone of initial dilution: HB2, HB3, HB4, HB5
- Edge of zone of mixing: HM1, HM2, HM3, HM4
- Beyond southwest corner of zone of mixing: HB6

Table 17: Single sample exceedances of 104 cfu/100 ml enterococcus concentration in monthly samples at Honouliuli offshore monitoring stations, June 1991 – October 2003.

Year	Sample events per year[1]	Samples per year at each depth	Number of **surface** samples above 104	Stations	Number of **bottom** samples above 104	Stations
1991	2	18	0		12	HB2, HB3, HB4,HB5, HB6, HM1, HM2, HM4
1992	4	36	3	HB4, HB5, HM4	12	HB1, HB2, HB3, HB4,HB5, HM3, HM4
1993	4	36	0		7	HB4, HB5, HB6, HM1, HM4
1994	4	36	0		14	HB2, HB3, HB4,HB5, HB6, HM1, HM2, HM3, HM4
1995	4	36	3	HB2, HB3, HB5	11	HB3, HB4, HB6, HM1, HM3, HM4
1996	4	36	5	HB3, HB4,HB5, HM1,	16	HB1, HB2, HB3, HB4,HB5, HM1, HM2, HM3, HM4
1997	2	18	0		2	HB5, HM1
1998	4	36	2	HM3, HM4	14	HB2, HB3, HB4,HB5, HB6, HM1, HM2, HM4
1999	4	36	5	HB4, HB5, HB6, HM1, HM4	9	HB3, HB4, HB5, HM4
2000	4	36	0		12	HB3, HB4,HB5, HB6, HM1, HM2, HM4
2001	4	36	6	HB4, HB6, HM1, HM3, HM4	10	HB2, HB3, HB4,HB5, HB6, HM1, HM2, HM3, HM4
2002	4	36	9	HB2, HB3, HB4,HB5, HM1, HM3	19	HB2, HB3, HB4,HB5, HB6, HM1, HM4
2003	5	45	10	HB2, HB3, HB4,HB5, HM1, HM3, HM4	18	HB2, HB3, HB4,HB5, HB6, HM2, HM3, HM4
Total	**49**	**441**	**43**		**156**	

[1] Surface and bottom samples taken at:

- Edge of zone of initial dilution: HB2, HB3, HB4, HB5
- Edge of zone of mixing: HM1, HM2, HM3, HM4
- Beyond southwest corner of zone of mixing: HB6

Table 18. Detected effluent concentrations for priority pollutants and pesticides and predicted concentrations after initial dilution.

Substance	**Maximum Effluent Concentration (ug/L)**[1]	**Maximum Detection Limit (ug/L)**[2]	**Maximum Concentration at ZID after critical initial dilution of 118 (ug/L)**[3]	**Maximum Concentration at ZID after average initial dilution of 412 (ug/L)**[4]	**Hawaii Water Quality Standards (ug/L)**			**Federal Water Quality Criteria**[8] **(ug/L)**				**Carcinogen**
					Acute[5]	Chronic[6]	Fish Consumption[7]	Acute	Chronic	Human Health - water and organism	Human Health - organism	
Antimony	1.8	2.0	0.015	0.0044	ns	ns	15000			5.6	640	
Arsenic	0.85	2.0	0.0072	0.0021	69	36	ns	69	36	0.018	0.14	
Beryllium	0.14	0.10	0.0012	0.00034	ns	ns	0.038					*
Cadmium	0.23	0.20	0.002	0.00056	43	9.3	ns	40	8.8			
Chromium (VI)	4.9	1.0	0.042	0.012	1100	50	ns	1100	50			
Copper	42	2.0	0.36	0.10	2.9	2.9	ns	4.8	3.1	1300		
Lead	2.4	1.0	0.020	0.0058	140	5.6	ns	210	8.1			
Mercury	0.11	0.20	0.0009	0.00027	2.1	0.025	0.047	1.8	0.94			
Nickel	4.5	2.0	0.038	0.011	75	8.3	33	74	8.2	610	4600	
Selenium	1.6	2.0	0.014	0.0039	300	71	ns	290	71	170	4200	
Silver	2.3	0.4	0.02	0.0056	2.3	ns	ns	1.9				
Thallium	ND				710	ns	16			0.24	0.47	
Zinc	100	10	0.85	0.24	95	86	ns	90	81	7400	26000	
Cyanide	ND				1	1	ns	1	1	140	140	
2,3,7,8-TCDD	ND				ns	ns	5.00E-09			5.0E-9	5.1E-9	
Acrolein	2.8	1.0	0.024	0.0068	18	ns	250			190	290	
Acrylonitrile	ND				ns	ns	0.21			0.051	0.25	*
Benzene	ND				1700	ns	13			2.2	51	*
Carbon tetrachloride	ND				16000	ns	2.3			0.23	1.6	*

[1] Maximum effluent concentration detected on scans conducted on December 3, 2003; August 17, 2004; and January 19, 2005.
[2] Maximum detection limit reported by CCH.
[3] Predicted concentration at the ZID boundary using the critical initial dilution of 118:1 and the reported maximum effluent concentration.
[4] Predicted concentration at the ZID boundary based on the average initial dilution of 412:1 and the reported maximum effluent concentration.
[5] Acute criteria contained in Hawaii water quality standards do not apply to submerged outfalls. Presented here only for reference.
[6] Chronic criteria contained in Hawaii water quality standards to protect aquatic life.
[7] Fish consumption criteria contained in Hawaii water quality standards to protect human health.
[8] EPA's 304(a) water quality criteria.

Substance	Maximum Effluent Concentration (ug/L)[1]	Maximum Detection Limit (ug/L)[2]	Maximum Concentration at ZID after critical initial dilution of 118 (ug/L)[3]	Maximum Concentration at ZID after average initial dilution of 412 (ug/L)[4]	Hawaii Water Quality Standards (ug/L)			Federal Water Quality Criteria[8] (ug/L)				Carcinogen
					Acute[5]	Chronic[6]	Fish Consumption[7]	Acute	Chronic	Human Health - water and organism	Human Health - organism	
Chloroform	1.5	2.0	0.013	0.0036	ns	ns	5.1			5.7	470	*
1,2-Dichloroethane	ND				38000	ns	79			0.38	37	*
1,1-Dichloroethylene	ND				75000	ns	0.6			330	7100	
1,2-Dichloropropane	ND				3400	ns	ns			0.50	15	
1,3-Dichloropropylene	ND				260	ns	4.6			?0.34?	21	
Ethylbenzene	ND				140	ns	1070			530	2100	
1,1,2,2-Tetrachloro ethane	ND				3000	ns	3.5			0.17	4.0	*
Tetrachloro ethylene	ND				3400	145	2.9			0.69	3.3	*
Toluene	3.3	5.0	0.028	0.0080	2100	ns	140000			1300	15000	*
1,1,1-Trichloroethane	ND				10400	ns	340000					
1,1,2-Trichloroethane	ND				ns	ns	14			0.59	16	*
Trichloroethylene	ND				700	ns	26			2.5	30	*
Vinyl chloride	ND				ns	ns	170			0.025	2.4	*
2-Chlorophenol	ND				ns	ns	ns			81	150	
2,4-Dichlorophenol	ND				ns	ns	ns			77	290	
2,4-Dimethylphenol	ND				ns	ns	ns			380	850	
2-Methyl-4,6-Dinitrophenol	ND				1600	ns	ns			13	280	
2,4-Dinitrophenol	ND				1600	ns	ns			69	5300	
2-Nitrophenol	ND				1600	ns	ns					
4-Nitrophenol	ND				1600	ns	ns					*
Pentachlorophenol	ND				13	ns	ns			0.27	3.0	
Phenol	5.2	9.7	0.044	0.013	170	ns	ns			21000	17000000	
2,4,6-Trichlorophenol	ND				ns	ns	1.2			1.4	2.4	*
Acenaphthene	ND				320	ns	ns			670	990	
Benzidine	ND				ns	ns	0.00017			0.000086	0.00020	*

Substance	Maximum Effluent Concentration (ug/L)[1]	Maximum Detection Limit (ug/L)[2]	Maximum Concentration at ZID after critical initial dilution of 118 (ug/L)[3]	Maximum Concentration at ZID after average initial dilution of 412 (ug/L)[4]	Hawaii Water Quality Standards (ug/L)			Federal Water Quality Criteria[8] (ug/L)				Carcinogen
					Acute[5]	Chronic[6]	Fish Consumption[7]	Acute	Chronic	Human Health - water and organism	Human Health - organism	
Bis(2-Chloroethyl)Ether	ND				ns	ns	0.44			0.030	0.53	*
Bis(2-Ethylhexyl) Phthalate	7	9.7	0.059	0.017	ns	ns	16000			1.2	2.2	
1,2-Dichlorobenzene	2.1	2	0.018	0.0051	660	ns	850			420	1300	*
3,3'Dichloro benzidene	ND				ns	ns	0.007			0.021	0.028	*
Diethyl Phthalate	4.7	9.7	0.04	0.011	ns	ns	590000			17000	44000	
Dimethyl Phthalate	ND				ns	ns	950000			270000	1100000	
Di-n-Butyl Phthalate	ND				ns	ns	50000			2000	4500	
2,4-Dinitrotoluene	ND				200	ns	3			0.11	3.4	
2,6-Dinitrotoluene	ND				200	ns	3					
1,2-Diphenyl hydrazine	ND				ns	ns	0.018			0.036	0.20	
Fluoranthene	ND				13	ns	18			130	140	
Hexachlorobenzene	ND				ns	ns	0.00024			0.00028	0.00029	*
Hexachloro butadiene	ND				11	ns	16			0.44	18	*
Hexachlorethane	ND				310	ns	2.9			1.4	3.3	
Isophorone	ND				ns	4300	ns			35	960	
Napthalene	ND				780	ns	ns					
Nitrobenzene	ND				2200	ns	ns			17	690	
N-Nitroso dimethylamine	ND				ns	ns	5.3			0.00069	3.0	
N-Nitrosodi-n-Propylamine	ND				ns	ns	30			0.0050	0.51	
N-Nitroso diphenylamine	ND				ns	ns	5.3			3.3	6.0	
Aldrin	ND				1.3	ns	0.000026	1.3		0.000049	0.000050	*
Gamma-BHC (Lindane)	ND				0.16	ns	0.020			0.98	1.8	*
Chlordane	0.1	0.1	0.00085	0.00024	0.09	0.004	0.000016	0.09	0.004	0.00080	0.00081	*

Substance	Maximum Effluent Concentration (ug/L)[1]	Maximum Detection Limit (ug/L)[2]	Maximum Concentration at ZID after critical initial dilution of 118 (ug/L)[3]	Maximum Concentration at ZID after average initial dilution of 412 (ug/L)[4]	Hawaii Water Quality Standards (ug/L)			Federal Water Quality Criteria[8] (ug/L)				Carcinogen
					Acute[5]	Chronic[6]	Fish Consumption[7]	Acute	Chronic	Human Health - water and organism	Human Health - organism	
4,4'-DDT	ND				0.013	0.001	0.000008	0.13	0.001	0.00022	0.00022	*
Dieldrin	0.055	0.009	0.00047	0.00013	0.71	0.0019	0.000025	0.71	0.0019	0.000052	0.000054	*
Endosulfan	ND				0.034	0.0087	52.0	0.034	0.0087	62	89	
Endrin	ND				0.037	0.0023	ns	0.037	0.0023	0.059	0.060	
Heptachlor	0.004	0.009	0.000034	0.0000097	0.053	0.0036	0.00009	0.053	0.0036	0.000079	0.000079	*
Toxaphene	ND				0.21	0.0002	0.00024	0.21	0.002	0.00028	0.00028	*
Demeton	ND				ns	0.1	ns					
Guthion	ND				ns	0.01	ns					
Malathion	ND				ns	0.1	ns					
Methoxyclor	ND				ns	0.03	ns					
Mirex	ND				ns	0.001	ns					
Parathion	ND				ns	ns	ns					
PAHs	ND				ns	ns	0.01					*
PCBs	ND				10	0.03	0.000079		0.03	0.000064	0.000064	*
Anthracene	ND									8300	40000	
Bromoform	ND									4.3	140	
Methylene chloride	0.7	2.0	0.006	0.0017						4.6	590	

Table 19. Toxicity test results reported on DMRs for *T. gratilla* test using the Dinnel method. Test results exceeding the State water quality standards are in bold print.

	Monthly Average TU_c (WQS: 118)	NOEC (WQS: NOEC ≥ 0.85% effluent)	Daily Maximum TU_c (WQS: 118)	NOEC (WQS: NOEC ≥ 0.85% effluent)
	TU_c	% Effluent	TU_c	% Effluent
September 2005	**> 520.8**	**< 0.19**	**>625**	**< 0.16**
October 2005	**157.5**	**0.63**	**312.5**	**0.32**
November 2005	**138.9**	**0.72**	**158.7**	**0.63**
December 2005	**158.7**	**0.63**	**158.7**	**0.63**
January 2006	**177.3**	**0.56**	**312.5**	**0.32**
February 2006	**177.3**	**0.56**	**312.5**	**0.32**
March 2006	109.1	0.91	**158.7**	**0.63**
April 2006	79.4	1.26	79.4	1.26
May 2006	**> 313.7**	**< 0.32**	**> 625**	**< 0.16**
June 2006	**> 345.2**	**< 0.29**	**> 625**	**< 0.16**
July 2006	**> 236**	**< 0.42**	**> 625**	**< 0.16**
August 2006	**> 401**	**< 0.25**	**> 625**	**< 0.16**
September 2006	**313.5**	**0.32**	**625**	**0.16**
October 2006	109.1	0.92	**158.7**	**0.63**
November 2006	**> 352.2**	**< 0.28**	**> 625**	**< 0.16**

Table 20. Toxicity test results from primary and final effluent.

T. gratilla Test Date	Primary Effluent		Final Effluent	
	TU_c	% Effluent	TU_c	% Effluent
September 14, 2005	312.5	0.32	312.5	0.32
October 6, 2005	312.5	0.32	158.7	0.63
December 6, 2005	312.5	0.32	158.7	0.63

Table 21. Annual geometric mean of ammonia nitrogen concentrations (ug/L) from quarterly samples taken at offshore monitoring stations (all three depths combined). Annual geometric mean values exceeding the State criterion (3.5 ug/L ammonia nitrogen) are marked in bold type.

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
ZID Stations	**HB2**	2.9	2.0	2.4	1.8	1.2	1.2	2.0	3.1	3.3	1.6	1.5	2.2	1.6	1.6	1.3	3.2
	HB3	3.8	2.3	3.3	1.9	4.5	1.9	1.9	2.6	3.6	2.3	1.2	2.5	2.4	1.8	1.6	4.7
	HB4	4.0	2.3	3.1	2.2	1.9	3.5	4.3	3.3	4.3	1.8	1.6	3.0	2.6	2.2	1.2	5.0
	HB5	4.0	2.3	2.8	2.0	1.4	2.8	2.9	6.3	5.7	5.1	3.1	4.8	4.1	3.1	3.2	5.9
ZOM Stations	**HM1**	3.4	2.0	2.3	1.3	1.0	2.0	1.9	3.3	2.8	2.6	1.6	2.0	1.6	1.9	1.7	2.7
	HM2	3.5	1.9	1.6	1.2	1.0	1.2	1.4	2.1	2.6	1.5	1.4	1.7	1.2	1.7	1.1	2.0
	HM3	2.3	1.9	1.9	1.1	1.6	1.3	1.5	2.2	2.9	1.5	1.3	2.6	2.1	1.6	1.1	2.0
	HM4	3.3	2.8	2.7	1.8	1.4	1.6	1.7	3.5	2.7	2.1	2.5	1.6	1.7	2.7	1.5	2.9
Beyond ZOM	**HB6**	2.0	1.9	3.7	2.0	1.8	1.1	2.1	2.3	2.7	1.6	1.9	1.8	1.1	1.9	1.5	3.7
Reference	**HB1**	1.5	1.9	1.8	1.0	1.0	1.0	1.3	2.1	1.9	1.1	1.0	1.3	1.1	1.2	1.2	1.6
	HB7	2.0	1.7	3.9	1.0	1.1	1.0	1.6	1.6	1.8	1.3	1.0	1.4	1.2	1.4	1.0	2.5

Table 22. Annual geometric mean of ammonia nitrogen concentrations (ug/L) from quarterly samples taken at **bottom** offshore monitoring stations. Annual geometric mean values exceeding the State criterion (3.5 ug/L ammonia nitrogen) are marked in bold type.

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
ZID Stations	**HB2**	**12.0**	1.8	1.8	2.8	1.6	1.8	2.1	**4.7**	**3.8**	1.7	2.7	**3.8**	2.1	1.9	2.3	**10.8**
	HB3	**19.9**	2.4	1.8	3.2	**10.6**	3.0	1.6	**5.8**	**6.6**	3.3	1.6	**5.0**	2.3	2.5	**3.9**	**12.3**
	HB4	**43.8**	2.4	3.3	**3.8**	2.1	**8.2**	**15.7**	**6.7**	**8.5**	2.8	1.6	**8.0**	**4.1**	**3.8**	1.9	**12.4**
	HB5	**9.5**	3.1	**6.6**	**4.1**	1.3	**11.9**	**6.3**	**20.5**	**12.6**	**14.8**	**5.3**	**35.6**	**6.3**	**5.0**	**12.2**	**31.7**
ZOM Stations	**HM1**	**11.2**	3.0	2.8	1.7	1.0	**4.3**	3.1	**11.4**	3.3	**4.3**	2.4	2.2	2.7	1.2	**5.1**	**9.2**
	HM2	**8.3**	2.8	1.8	1.6	1.0	1.8	1.9	3.0	3.0	2.0	2.2	2.4	1.3	1.9	1.4	**5.8**
	HM3	3.5	2.4	1.8	1.0	**4.0**	1.9	2.4	**3.6**	**3.7**	1.4	2.3	2.6	2.5	2.9	1.0	2.6
	HM4	**8.9**	3.2	**4.4**	2.3	2.0	2.1	3.2	**5.3**	**3.7**	**4.2**	2.0	2.9	2.4	**6.1**	3.4	**5.4**
Beyond ZOM	**HB6**	3.5	2.5	**4.4**	**4.2**	**5.5**	1.0	2.2	**4.9**	2.3	2.2	2.0	3.5	1.3	2.2	3.3	**6.1**
Reference	**HB1**	2.5	2.3	1.8	1.0	1.0	1.0	1.4	3.1	2.2	1.4	1.0	1.4	1.1	1.2	1.6	1.7
	HB7	3.2	1.9	**4.1**	1.0	1.0	1.0	1.8	1.9	1.7	1.3	1.0	1.5	1.0	1.6	1.0	2.8

Table 23. Annual geometric mean of ammonia nitrogen concentrations (ug/L) from quarterly samples taken at **mid-depth** offshore monitoring stations. Annual geometric mean values exceeding the State criterion (3.5 ug/L ammonia nitrogen) are marked in bold type.

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
ZID Stations	**HB2**	1.4	2.4	**4.2**	2.1	1.0	1.0	2.6	3.0	3.4	1.9	1.2	1.5	1.2	1.8	1.0	2.2
	HB3	1.4	2.5	**7.4**	2.1	**3.6**	1.0	3.0	2.1	2.7	2.2	1.0	1.9	2.8	1.9	1.0	3.0
	HB4	1.0	3.1	**3.8**	2.8	3.1	2.6	**3.8**	3.4	3.0	1.4	1.0	1.6	1.6	2.4	1.0	**4.4**
	HB5	3.5	2.3	**14.6**	1.4	1.3	1.0	2.6	**8.4**	**4.8**	**4.1**	**5.4**	1.3	3.2	2.3	1.5	3.3
ZOM Stations	**HM1**	2.4	1.5	1.8	1.2	1.0	1.0	2.3	2.2	2.6	2.1	1.9	1.7	1.1	1.7	1.0	1.6
	HM2	**3.7**	1.6	1.6	1.0	1.0	1.0	1.4	2.1	2.5	1.6	1.2	1.3	1.0	2.0	1.0	1.7
	HM3	1.4	1.7	2.1	1.5	1.0	1.0	1.4	1.9	3.0	1.3	1.0	**5.6**	1.8	2.9	1.3	2.5
	HM4	2.0	**3.7**	2.1	2.0	1.4	1.0	1.4	2.4	1.7	1.6	2.2	1.2	1.1	2.5	1.0	3.1
Beyond ZOM	**HB6**	1.7	1.8		1.4	1.0	1.0	2.2	1.7	2.1	1.5	2.0	1.3	1.2	2.4	1.0	**3.7**
Reference	**HB1**	1.4	1.7	**5.1** 2.1	1.0	1.0	1.0	1.4	2.0	1.9	1.3	1.0	1.3	1.2	1.2	1.0	2.0
	HB7	1.7	2.0	**4.5**	1.0	1.0	1.0	1.6	1.6	1.7	1.3	1.0	1.3	1.2	1.4	1.0	3.1

Table 24. Annual geometric mean of ammonia nitrogen concentrations (ug/L) from quarterly samples taken at **surface** offshore monitoring stations. Annual geometric mean values exceeding the State criterion (3.5 ug/L ammonia nitrogen) are marked in bold type.

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
ZID Stations	**HB2**	1.4	1.8	1.8	1.0	1.6	1.0	1.4	2.1	2.7	1.3	1.0	1.8	1.7	1.2	1.0	1.4
	HB3	1.4	2.0	2.9	1.0	2.4	2.2	1.4	1.4	2.7	1.7	1.0	1.6	2.2	1.2	1.0	2.8
	HB4	1.4	1.6	2.4	1.0	1.7	2.0	1.3	1.7	3.0	1.6	2.7	2.1	2.6	1.2	1.0	2.3
	HB5	2.0	1.7	**5.0**	1.4	1.6	1.9	1.5	1.4	3.1	2.2	1.0	2.3	3.4	2.6	1.8	2.0
ZOM Stations	**HM1**	1.4	1.9	2.4	1.0	1.0	1.9	1.0	1.4	2.5	1.9	1.0	2.1	1.4	2.3	1.0	1.4
	HM2	1.4	1.6	1.5	1.0	1.0	1.0	1.0	1.4	2.4	1.2	1.0	1.7	1.1	1.2	1.0	1.4
	HM3	2.6	1.6	1.8	1.0	1.0	1.3	1.0	1.6	2.2	1.9	1.0	1.2	2.0	1.2	1.0	1.2
	HM4	2.0	1.8	2.1	1.3	1.0	1.9	1.0	3.5	3.1	1.4	3.4	1.2	1.7	1.3	1.0	1.4
Beyond ZOM	**HB6**	1.4	1.4	2.2	1.4	1.0	1.2	1.8	1.4	**3.9**	1.2	1.8	1.3	1.0	1.3	1.0	2.2
Reference	**HB1**	1.0	1.7	1.5	1.0	1.0	1.0	1.2	1.6	1.7	1.3	1.0	1.2	1.0	1.2	1.0	1.2
	HB7	1.4	1.4	3.3	1.0	1.2	1.0	1.5	1.4	2.0	1.2	1.0	1.5	1.1	1.2	1.0	1.9

Table 25. Range of Metal Concentrations Detected in Fish Muscle Tissue (ug/kg or ppb).

Range of Metal Concentrations Detected in Fish Muscle Tissue (ug/kg or ppb)			
Metal	Akule	Menpachi	Ta'ape
Antimony	57 – 590	50 -820	68 – 640
Arsenic (inorganic)	400 – 5,700	7,800 – 21,700	1,100 – 7,800
Beryllium	3 – 10	2 – 10	3 – 4
Cadmium	9 – 40	10 – 20	10
Chromium (total)	40 – 140	50 – 100	50 -110
Copper	760 – 2,700	110 – 220	170 – 390
Lead	20 – 240	30 – 250	80 – 270
Mercury	30 -128	26 – 150	8 – 160
Selenium	600 – 1,200	420 – 1,100	340 – 810
Silver	30 – 40	20 – 50	30 – 42
Thallium	110	60	91
Zinc	1,700 – 10,300	2,100 – 4,800	2,300 – 3,800

Table 26. Projected annual average effluent flows and BOD and TSS concentrations and mass emission rates for HWWTP.

	1994 actual	2005	2010	2015	2020
Average annual flow m^3/sec - MGD -	1.12 26.0	1.50 34	1.58 36	1.67 38	1.75 40
Effluent BOD_5 mg/l	160	200	200	200	200
Effluent TSS mg/l	59	95	95	95	95