3 BASIS OF DESIGN CRITERIA USED TO DEVELOP SECONDARY TREATMENT AND EXPANSION ALTERNATIVES

The following sections describe the basis of design criteria used to develop alternatives for secondary treatment and expansion of the facility to accommodate future projected wastewater flow. The basis of design criteria was determined based on existing and anticipated standards. In addition, the criteria include consideration for effluent reuse.

3.1 Previous Basin Planning

The *Final Sewer Infiltration and Inflow Plan* (*Final Sewer I/I Plan*) was completed in 1999 in compliance with requirements of a Consent Decree (Civ. No. 94-00765 DAE dated May 15, 1995) between the CCH, DOH, and EPA. The *Final Sewer I/I Plan* established infiltration and inflow rates for each wastewater sewer basin (including the Honouliuli sewer basin).

The flow information gathered as part of the *Final Sewer I/I Plan* was used to populate the Sewer Flow Analysis System (SFAS) Flow Model. The SFAS model has been used to estimate existing and future wastewater flows. The *West Mamala Bay Facilities Plan* (Wilson Okamoto & Associates, Inc. and Brown and Caldwell Consultants 2001) used the SFAS model to project the 2020 peak wet weather flow to the WWTP to be 174 mgd. In addition to the flow at the WWTP, the model showed that a number of the sewers and force mains would have insufficient capacity.

The *West Mamala Bay Facilities Plan* (Wilson Okamoto & Associates, Inc. and Brown and Caldwell Consultants 2001) provided recommendations for upgrades to the Honouliuli WWTP, including odor control, preliminary and primary treatment expansion, effluent pump station, and solids handling modification. The Plan recommended that upgrading to secondary treatment (beyond the 13 mgd in 1999) would not be necessary; however, the Consent Decree requirements superseded this recommendation. The recommendations for odor control and sludge management are being evaluated as part of the Honouliuli Fac Plan.

The CCH has completed the *Final Sewer I/I Plan* with the *Sewer I/I Assessment and Rehabilitation Program Update* project. The first phase of this project installed flow meters and rain gauges throughout the island of Oahu. The flow metering was conducted from 2009 to 2011. The flow data collected was entered into an InfoWorks Model that was used to route flows through the collection and transport system to generate projected flows at the Honouliuli WWTP. The projected 2050 peak wet weather flow from this effort was 126 mgd, which is lower than the projected peak flows derived from the preceding studies. The *Wet Weather I/I Assessment Update Report* (AECOM 2013) summarizes the second phase of the project, which included some additional intensive monitoring conducted from 2011 to 2012 and provided future project recommendations based on monitoring and modeling.

3.1.1 Sludge Management Plan

The Island-wide Sludge Management Plan was completed in 2015. With respect to Honouliuli WWTP, the plan recommended a final sludge processing, hauling, and beneficial use strategy. Key aspects of the plan include accommodating the following:

- Waimanalo Gulch landfill’s goal of eventual elimination of sludge receiving
- Future expansion of Honouliuli WWTP from partial secondary to full secondary
- Anticipated growth in the Honouliuli wastewater basin

3.1.2 Odor Control

The Honouliuli Wastewater Basin Odor Control Project is ongoing. The project scope addresses odor and corrosion concerns in both the WWTP and tributary collection system. Planning was completed by October 2015. Areas of concern and potential alternatives have been identified in the Preliminary Engineering Report (AECOM 2014b). Pilot testing for collection system and WWTP controls has been completed and design of improvements was completed by March 2017.

3.2 Population Projections

The Honouliuli WWTP provides service to the developed areas in the region around Pearl Harbor, from Halawa in the east to Ko Olina in the west, and extending to Mililani in the north. Figure 1-1 identifies the Honouliuli sewer basin boundary. The Honouliuli WWTP services the communities of Halawa, Aiea, Waimalu, Pearl City, Pacific Palisades, Waiawa, Waipahu, Mililani, Waipio, Village Park, Crestview, Waikele, Kunia, Kapolei, West Loch, Ewa Beach, Makakilo, and Ko Olina. The total service area includes approximately 22,000 acres of developed land and 54,000 acres of undeveloped land.

To determine system capacity requirements within the planning period, Honouliuli sewer basin population projections were developed for the year 2035 and year 2050. Conducting the population projections entailed a substantial data collection effort. Key agencies contacted include the Hawaii Department of Business, Economic Development, and Tourism (DBEDT) and CCH Department of Planning and Permitting (DPP), which are responsible for conducting socioeconomic projections for Hawaii and the island of Oahu, respectively. In addition, numerous planning reports and data were reviewed, including the following (listed chronologically):

- *General Plan: Objectives and Policies*, Amended October 2002 (CCH DPP) (according to the DPP website, this plan is in the process of being updated)
- Central Oahu Sustainable Communities Plan, December 2002 (CCH DPP)
- Primary Urban Center Development Plan, June 2004 (CCH DPP)
- Population and Economic Projections for the State of Hawaii to 2035, July 2009 (Hawaii DBEDT)
- CCH Socioeconomic Projections to 2035, September 2009 (CCH DPP)
- Honouliuli High-Capacity Transit Corridor Project Final Environmental Impact Statement/Section 4(f) Evaluation, June 2010 (CCH and US Department of Transportation)
- Annual Report on the Status of Land Use on Oahu: Fiscal Year 2009, August 2010 (CCH DPP)
- Get on Board! Transit Oriented Development Handbook, Spring 2011 (CCH DPP)
- *Oahu Regional Transportation Plan 2035*, April 2011 (Oahu Metropolitan Planning Organization)
- Proposed Revised Ewa Development Plan, May 2011 (CCH DPP)
- 2010 Census Summary File 1 for Hawaii, June 2011 (US Census Bureau)
- *2010 Annual Visitor Research Report*, September 2011 (Hawaii Tourism Authority)

The projections consider long-term, historic trends for the sewer basin, as well as available data and projections released by CCH and large-scale developments and proposed projects in the area. Previously conducted population and employment projections were also referenced to assist with the effort. The source most relied on was the CCH DPP socioeconomic projections to 2035, which are generally used and accepted for county infrastructure planning efforts (AECOM 2011a).

Based on the range of data available at the start of the analysis, the year 2010 was chosen as the current design year. In 2010, a population of over 300,000 was served by the Honouliuli sewer basin. Year 2035 and the corresponding population estimates were used in the evaluation and comparison of alternatives. Population projections to year 2050 were used in reference to the projected build-out of the Honouliuli WWTP. Population projections are provided in Table 3-1. The “population equivalent” values reflect an adjustment of the population projections based on average wastewater use by population category. These values were used to facilitate computation of per capita sanitary flows/loadings. The population projections methodology and detailed results are provided in Appendix A.

Table 3-1. Population Projections

Sewered Area [1]	Projection Update								
	2010 [1]			2035			2050		
	Res	Non-Res	Visitor	Res	Non-Res	Visitor	Res	Non-Res	Visitor
Total	306,417	102,857	1,902	408,234	201,302	11,359	449,424	241,720	14,989
Population Equivalent	325,976 [2]			452,938 [2]			504,239 [2]		

Source: Honouliuli Fac Plan Work Task 4.F.1 – Updated Basis of Design Population, Flows, and Loads Technical Memorandum (AECOM 2012a).
Notes:
[1] Results do not include the following estimated population not served by sewer (based on comparison of aerial photographs and limits of existing collection system): 9,177 Residential; 17,095 Non-Residential.
[2] The following equation was used to arrive at a population value to facilitate computation of per capita sanitary flows/loadings: Population Equivalent = Res Pop. + (11/63) × Non-Res Pop. + (53/63) × Visitor Pop. (63, 11, and 53 are gallons per capita per day wastewater generation values for residential, non-residential, and visitor, respectively).

3.3 Flow Projections

Flows at the Honouliuli WWTP were projected to assist in determining the design capacity for the proposed improvements. Development of flow projections for the intermediate design year of 2035 and design year of 2050 involved development of projections for each of three components of the flow (sanitary flow, dry weather infiltration, and wet weather infiltration/inflow (I/I)). Flow projections were based initially on measurements of actual flows from flow metering conducted in the 2009-2012 period as part of the *Sewer I/I Assessment and Rehabilitation Program Update* project. Projections of future flows were then based on population projections (described above) and anticipated areas of new development within the sewer basin. A calibrated InfoWorks model was used to route flows through the collection and transport system to generate projected flows at the Honouliuli WWTP.

Table 3-2 shows typical year (dry and wet days that make up a “typical” year) flow projections and Table 3-3 shows flow projections for years 2010, 2035, and 2050 that would occur during a 2-year, 6-hour design storm. The flow projections methodology and detailed results are provided in Appendix A.

Table 3-2. Flow Projections from the Honouliuli System Model

Location	Typical Year (MGD)								
	Peak 1 Hour			Maximum 24 Hour			Annual Average		
	2010	2035	2050	2010	2035	2050	2010	2035	2050
WWTP	49.5	69.7	79.5	33.8	50.3	57.0	27.5	39.6	44.4

This table shows total flow (i.e., sanitary flow, dry weather infiltration, and wet-weather infiltration/inflow).
Source: Honouliuli Fac Plan Work Task 4.F.1 – Updated Basis of Design Population, Flows, and Loads Technical Memorandum (AECOM 2012a).

Table 3-3. Storm Flow Projections from the Honouliuli System Model

Location	2 Year, 6 Hour Storm (MGD)					
	Peak 1 Hour			Maximum 24 Hour		
	2010	2035	2050	2010	2035	2050
WWTP	82.2	114.2	126.4	45.0	65.4	73.5

This table shows total flow (i.e., sanitary flow, dry weather infiltration, and wet-weather infiltration/inflow).
Source: Honouliuli Fac Plan Work Task 4.F.1 – Updated Basis of Design Population, Flows, and Loads Technical Memorandum (AECOM 2012a).

The following design storm intervals were then evaluated as part of the *Sewer I/I Assessment and Rehabilitation Program Update* to identify capacity constraints in order to help define and prioritize proposed improvements, which are summarized in Table 3-4.

- 1-year, 6-hour
- 2-year, 6-hour
- 5-year, 6-hour
- 10-year, 6-hour
- 1-year, 24-hour
- 2-year, 24-hour
- 5-year, 24-hour
- 10-year, 24-hour

Table 3-4. Honouliuli Basin Proposed Improvements, Modeling Results

Description	Units	1-Year	2-Year	5-Year	10-Year
Gravity Pipes					
No. of Gravity Pipes	(Count)	N/A	9	42	100
Length of Gravity Pipes	(LF)	N/A	490	7,632	18,634
Force Mains					
No. of Force Mains	(Count)	0	0	0	0
Length of Force Mains	(LF)	0	0	0	0
WWPS					
Waimalu WWPS (23.82 MGD)	MGD	N/A	N/A	N/A	27.01

Source: Sewer I/I Assessment and Rehabilitation Program Update – Final Peak Flow Cost-Effective Analysis Report (AECOM 2012b)

3.4 Anticipated Ocean Discharge Permit Requirements

The Honouliuli WWTP needs to be upgraded to a secondary treatment facility by Year 2024, in accordance with the FACD. Table 3-5 presents the anticipated secondary effluent requirements after the WWTP has been upgraded. These requirements are set by the EPA.

Table 3-5. Anticipated Secondary Effluent Requirements

Parameter [1]	30-day Average Concentration (mg/L)	7-day Average Concentration (mg/L)
BOD_5 [2]	30	45
TSS [2]	30	45

Legend: BOD_5 = biochemical oxygen demand of wastewater during decomposition occurring over a 5-day period; CBOD = carbonaceous biochemical oxygen demand; TSS = total suspended solids.
Source: 40 Code of Federal Regulations (CFR) Section 133.102 Secondary Treatment (2011).
Notes:
(1) Required effluent pH between 6 to 9.
(2) The 30-day average percent removal shall not be less than 85 percent (57 mg/L and 59 mg/L for BOD_5 and TSS, respectively, based on 2011 average daily values). Therefore, the 30 mg/L limit is more stringent for both BOD_5 and TSS.

3.5 Basis of Design Influent and Effluent Quality and Quantity

The proposed Honouliuli WWTP sizing is based on Year 2050 flows and loads, although phasing for construction of structures was also considered. The peak wet weather flows, used in conjunction with representative wastewater concentrations to compute loads, and for design of the facilities, are based on the InfoWorks model identified in the previous section using a 2-year, 6-hour storm. Table 3-6 presents basis of design criteria for Years 2010, 2024 (initial year of new plant operation), 2035, and 2050 influent flows and corresponding loads. Additional detail regarding the load projections is provided in Appendix A.

Table 3-6. Basis of Design Influent Flows and Loads

Year	Avg. Day (mgd)	Max Day (mgd)	Peak Hr (mgd)	BOD_5 (lb/day)	TSS (lb/day)	TKN (lb/day)	NH_3 (lb/day)	TP (lb/day)
2010	27.5 [2]	33.8 [2]	82.2 [2]	78,000	81,000	7,900	5,800	1,000
2010 without Import Sludge [1]	27.5 [2]	33.8 [2]	82.2 [2]	74,000 (347 mg/L)	77,000 (360 mg/L)	7,500 (35 mg/L)	5,400 (25 mg/L)	900 (4.1 mg/L)
2024	36	45	101	91,000 [3]	94,000 [3]	9,300 [3]	6,500 [3]	1,100 [3]
2035	40	50	114	102,000 [3]	106,000 [3]	10,500 [3]	7,300 [3]	1,200 [3]
2050	45	57	126	114,000 [3]	118,000 [3]	11,600 [3]	8,100 [3]	1,400 [3]

Legend: NH_3 = Ammonia; TKN = Total Kjeldahl Nitrogen; TP = total phosphorus.
Source: Honouliuli Fac Plan Work Task 4.F.1 – Updated Basis of Design Population, Flows, and Loads Technical Memorandum (AECOM 2012).
Notes:
(1) Import sludge refers to sludge hauled from Paalaa Kai and Wahiawa WWTPs.
(2) 2010 flows shown are the calibrated flows from the InfoWorks model and are slightly higher than the actual flow.
(3) Based on 2010 without Import Sludge Concentrations.

The primary effluent quality will have an impact on the sizing of the proposed secondary treatment processes required for the upgrade and expansion of the Honouliuli WWTP for Year 2035 and 2050 conditions. With no additional primary clarifiers, it is anticipated that the removal efficiencies will decline as the flows and loads to the primary clarifiers increase. For Year 2050 conditions, used as the basis for sizing secondary treatment options, primary treatment removal efficiencies of 40 percent for BOD5 and 60 percent for total suspended (non-filterable) solids (TSS) were assumed. The basis of design effluent criteria is the anticipated secondary effluent requirements as shown in Table 3-5.

Additional secondary treated effluent will be available following the secondary treatment upgrade, which will provide an opportunity for additional water reuse including groundwater recharge. Currently, effluent reuse limits are presented in the *Reuse Guidelines* and *Hawaii Administrative Rules, Title 11 Department of Health Chapter 62 Wastewater Systems* (DOH 2016).

3.6 Design Standards

Alternative upgrades to the existing wastewater treatment system will be in accordance with the CCH's Design Standards of the Department of Wastewater Management, Volume 1 (DWM 1993), Design Standards of the Division of Wastewater Management, Volume 2 (DPW 1984), collectively referred to as the Wastewater Design Standards, and subsequent updates to these standards. Where supplemental standards are required, the *Recommended Standards for Wastewater Facilities* (commonly referred to as the Ten States Standards) (Health Research, Inc. 2004) and typical standards of practice will be used.