Impact on Water Resources of the Olowalu Town Project

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Table of Contents

List of Figures

List of Tables

Introduction

The proposed Olowalu Town Master Plan project would create a new residential community on 635 acres in Olowalu, West Maui (refer to the land use plan on Figure 1). At full build-out, the community would consist of up to 1500 residential units and related commercial, public, park, and open space land uses. Figure 2 identifies the land areas that would require a State District boundary amendment from agriculture to urban and rural in order to develop the project. The objective of this report is to quantify and assess the project's potential impact on water resources.

Project Infrastructure That Will Impact Water Resources

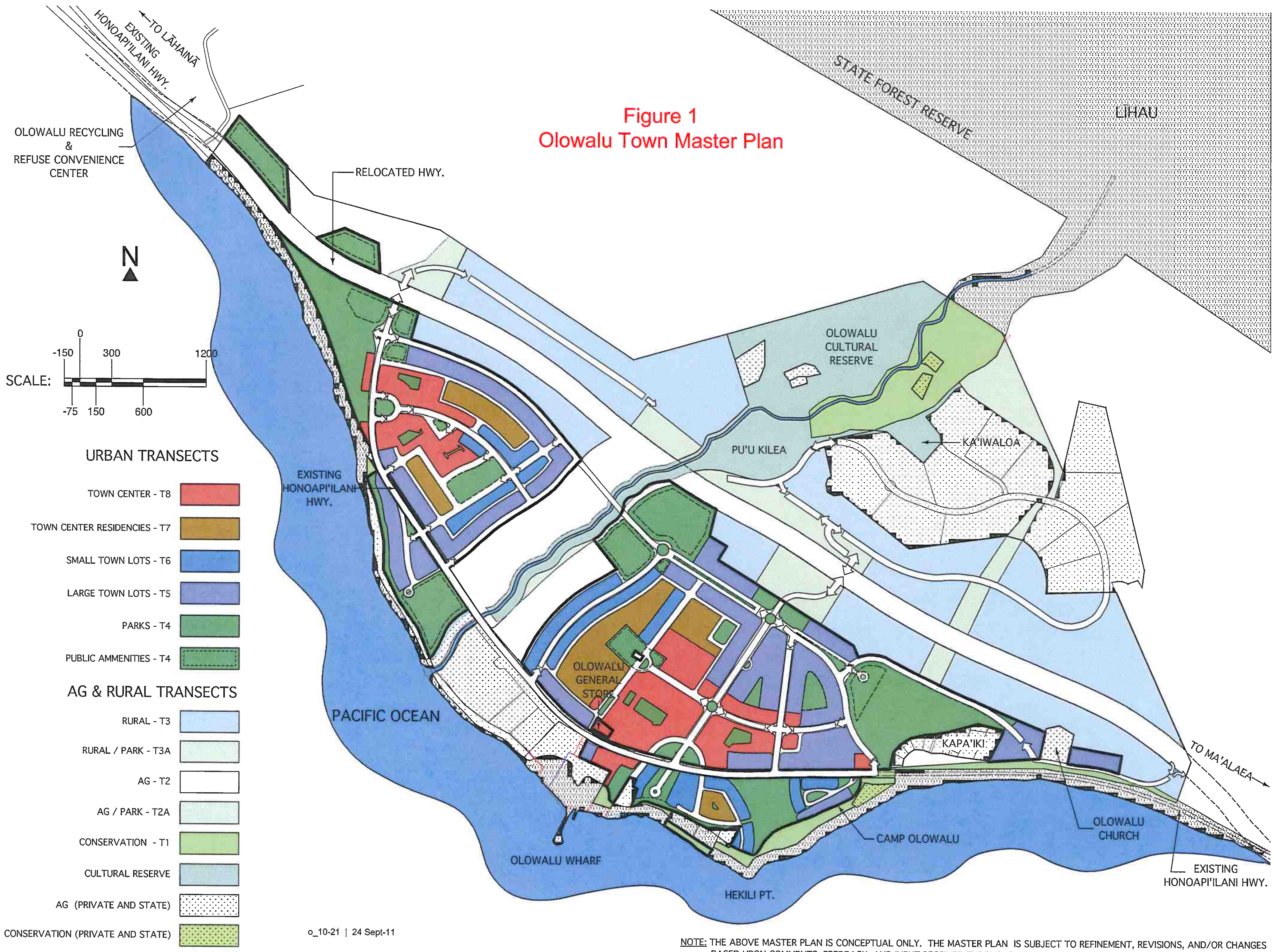
Potable Water System. The potable water system run by Olowalu Water Company, Inc. (OWC) has been designated by the State Department of Health as Public Water System No. 209. The water system presently supplies the 14-lot Olowalu Agricultural Subdivision, the five-lot Olowalu Makai Subdivision, Kapaiki Village, Olowalu General Store, and a number of other users within Olowalu. The system consists of one well (State No. 4936-01) at 205-foot elevation which is outfitted with a 250 GPM pump, a 0.50-million gallon (MG) storage tank with a 385-foot spillway, and distribution system piping. As shown on Figure 3, year-round average supply for PWS 209 has varied between 0.04 and 0.06 million gallons per day (MGD) over the four-year period from January 2007 through December 2010.

All of the Olowalu Town Master Plan project site is within the service area of PWS 209. Required expansion of the system to supply the Olowalu Town Master Plan project will be done incrementally and will ultimately include:

- Replacing the existing 250 GPM pump in Well 4936-01 with a unit of larger capacity on the order of 400 GPM;
- Constructing two more wells of similar (400 GPM) capacity, one of which will serve as standby;
- Adding additional reservoir storage next to the 0.50 MG tank, possibly of 0.50 or 1.0 MG size depending on actual water use; and
- Expansion of the existing distribution pipe network, including hydrants for fire protection.

Non-Potable Irrigation System. OWC also operates and maintains an existing non-potable irrigation system which serves ongoing agricultural and landscape irrigation in the project area. It consists of a diversion from Olowalu Stream at 502-foot elevation, a 1.1-mile long conveyance ditch and tunnel system, and a main open storage reservoir at about 360-foot elevation. The low head diversion dam on Olowalu Stream and the conveyance ditch system, referred to as Olowalu Ditch, was installed by Pioneer Mill Company sometime prior to 1911. The open reservoir, which has an impervious liner and was also installed by Pioneer Mill, is of more recent vintage. The system also has three other lower elevation and unlined reservoirs, one of which is still in use.

Figure 1
Olowalu Town Master Plan



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<u>NOTE:</u> THE ABOVE MASTER PLAN IS CONCEPTUAL ONLY. THE MASTER PLAN IS SUBJECT TO REFINEMENT, REVISIONS, AND/OR CHANGES BASED UPON COMMENTS, FEEDBACK, AND INPUT RECEIVED THROUGHOUT THE LAND USE ENTITLEMENT REVIEW PROCESS.

Figure 2
Proposed State Land Use Designation for the Olowalu Town Master Plan

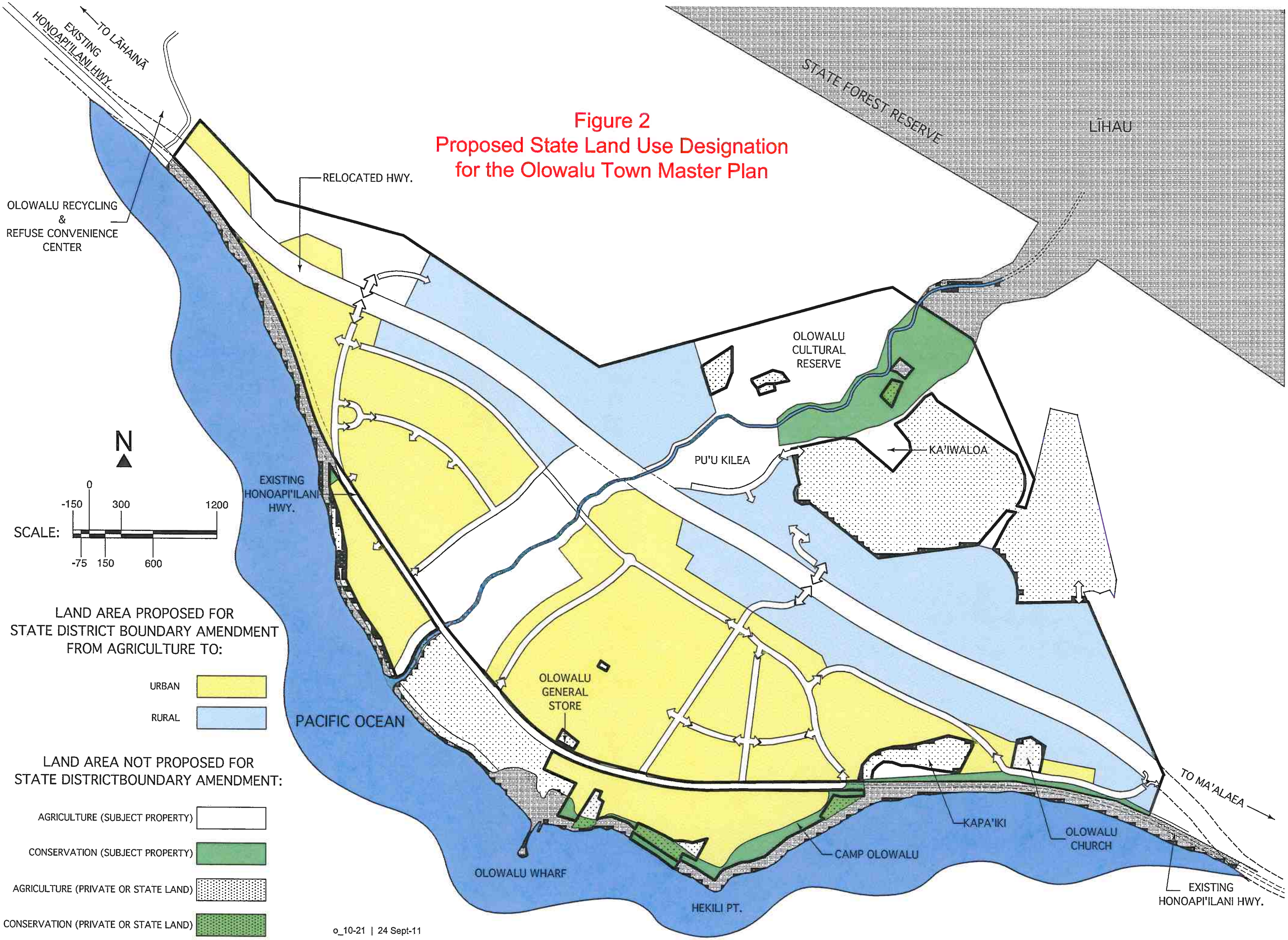

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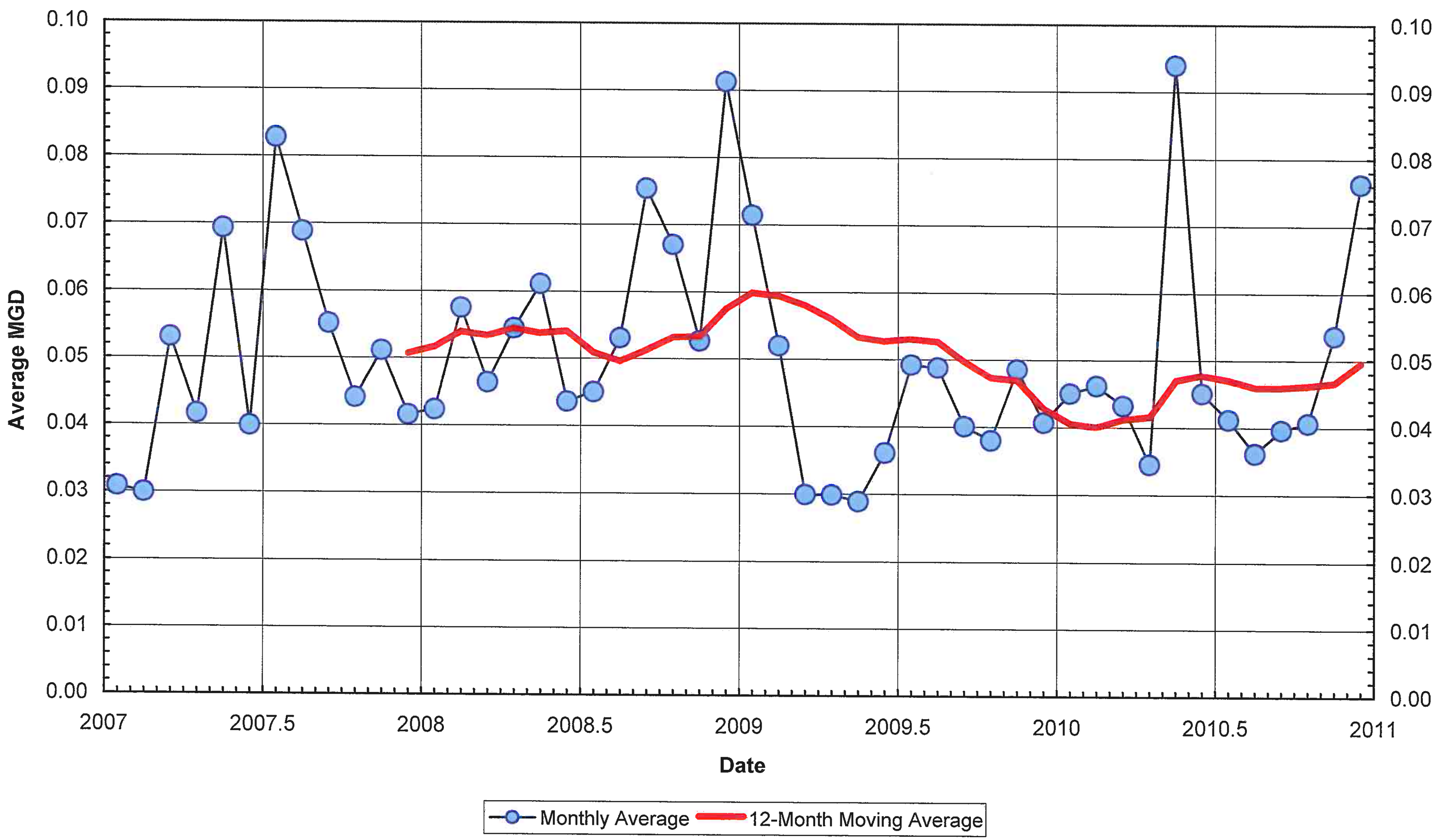
Figure 3. Monthly Pumpage of the Olowalu-Elua Well, State No. 4936-01, January 2007 through December 2010 (Data from Olowalu Water Company)



Historically, the ditch system has averaged four to five MGD and daily flows have rarely dropped below two MGD. With proper maintenance, including cleaning of sediment and debris and repairing of leaks, the ditch system should be able to accommodate the additional non-potable irrigation requirements of the Olowalu Town project. However, there are also two existing skimming wells within the project site. One is identified as State Well No. 4937-01. It is also known as the Olowalu Shaft and Pump N. It was previously used by Pioneer Mill, but is currently unused and is available as a back up source of slightly brackish non-potable supply. The other onsite skimming well, State Well 4837-01 (the O Pump), is also unused and available.

Wastewater Treatment, Reuse, and Disposal. A membrane bioreactor (MBR) treatment plant will be constructed onsite to treat project-generated wastewater to R-1 (tertiary) quality. Most of the treated effluent will be reused for the project's irrigation. About 100 acres within the project have been identified for this irrigation reuse. Early in the project's development and possibly on a seasonal basis at full build out, the non-potable irrigation system will provide supplemental supply to the 100-acre area. In wet periods when there is an excess of R-1 treated effluent, the excess will pass through a two-acre constructed wetlands and the effluent from the wetlands will be disposed of in a large (4.7-acre) leach field.

Drainage System. The project site is crossed by Olowalu Stream and several other, much smaller and unnamed normally dry gulches. Due to the impervious surfaces that would be created, development of the Olowalu Town project would increase the peak rate of surface runoff and the runoff volume. The intent of the project's drainage system is to provide sufficient volume in onsite retention basins so that the peak runoff rates and volumes for a 100-year, 24-hour design storm will not be increased over existing conditions. By providing these retention volumes, runoff rates and volumes for lesser storms from the project site are likely to be less than for existing conditions.

Hydro-Geologic Description of the Project Site

Overview of the Olowalu Watershed. The Olowalu watershed, which extends inland to the mountain crest above 4000-foot elevation, encompasses 5.05 square miles. Above 400-foot elevation, the exposed valley walls are deeply eroded Wailuku series basalts with numerous intruded dikes. Below 400-foot elevation, the land is covered with alluvium washed down by Olowalu Stream to form the fan-shaped coastal area. A prominent protrusion through the alluvium is Puu Kilea. It was formed by a more recent, Lahaina series eruption, but its flow lavas, if any, are buried under the alluvium. Notably, all of the Olowalu Town project site, as well as the existing Olowalu Agricultural Subdivision, are on the alluvium.

At the inland edge of watershed, rainfall averages about 200 inches per year. However, it rapidly drops off moving makai and is typically less than 20 inches a year across the project site.

Olowalu Stream and Ditch Flow. Despite the watershed's relatively small size and modest rainfall on its lower half, its streamflow is highly productive and perennial down to 200-foot elevation. Sometime prior to 1911, Pioneer Mill installed two ditch diversions for hydropower, sugarcane irrigation, and potable consumption in Olowalu camp. The upper diversion was created by the construction of a low head, boulder and concrete dam across the stream at 520-foot elevation. This diversion captures essentially all of the stream's base flow at that point. The U.S. Geological Survey (USGS), with assistance from Pioneer Mill personnel, measured the flow diverted into the ditch from 1911 to 1967. This measurement, essentially a depiction of the stream's base flow at 520-foot elevation, was remarkably consistent:

- Figure 4 is a plot of daily ditch flowrates over the 56-year period of record. Average flowrate over this period was 4.8 MGD. Some of the days when recorded flowrates were less than 2.0 MGD were the result of shutdowns for maintenance rather than actual low flows.

- Figure 5 is the duration-discharge curve for the 56 years of record, again showing the consistency of the ditch flow. Daily flowrates greater than 2.0 MGD occurred on 98 percent of the days.

- As shown by the high silica concentrations in samples of the stream and ditch taken on July 11, 2010 during an extended dry period, flow in the stream at the point of diversion is primarily groundwater discharged from high level, dike confined compartments (refer to Table 1). This explains the consistency of the stream's base flow captured at the ditch diversion.

It should be noted that West Maui Land Company Inc. has resumed measurement of the flow diverted into the Olowalu Ditch, albeit at a location further from the point of diversion than previously measured by Pioneer Mill and the USGS. Over the four-year period ending in December 2010, the ditch flowrate averaged 3.5 MGD. This is less than the 4.8 MGD average over the 1911 to 1967 period. Some of this difference is attributable to the dry recent period. However, ditch maintenance and leakage between the point of diversion and the location of current flowrate measurements are also contributing factors.

On low flow days such as observed on June 11 and 26, 2010, the upper ditch diversion captures all of the stream's flow. Except for minor seepage around and beneath the low head diversion dam, the streambed immediately downgradient is dry. However, within 100 yards, streamflow emerges and gradually gains in magnitude down to about 215-foot elevation, a distance of over a mile. At this lower location, Pioneer Mill installed a second ditch diversion. Although it is not known which of the two ditch diversions was installed first, notes in a 1911 USGS publication indicate that both diversions were being used at that time. However, the lower one, with obviously less yield, appears to have been abandoned sometime before the mid-1950s. The lower diversion dam, similar in structure to the upper one, has been destroyed by past storms. As observed on June 11 and 26, 2010, the stream's flowrate at the lower diversion structure was on the order of 15 to 20 percent of the flowrate at the upper diversion. Also, the

Figure 4. Daily and Moving Annual Average of Olowalu Ditch Flowrate as Measured at USGS Gage 6450 from 1911 to 1967 (Data from USGS Website)

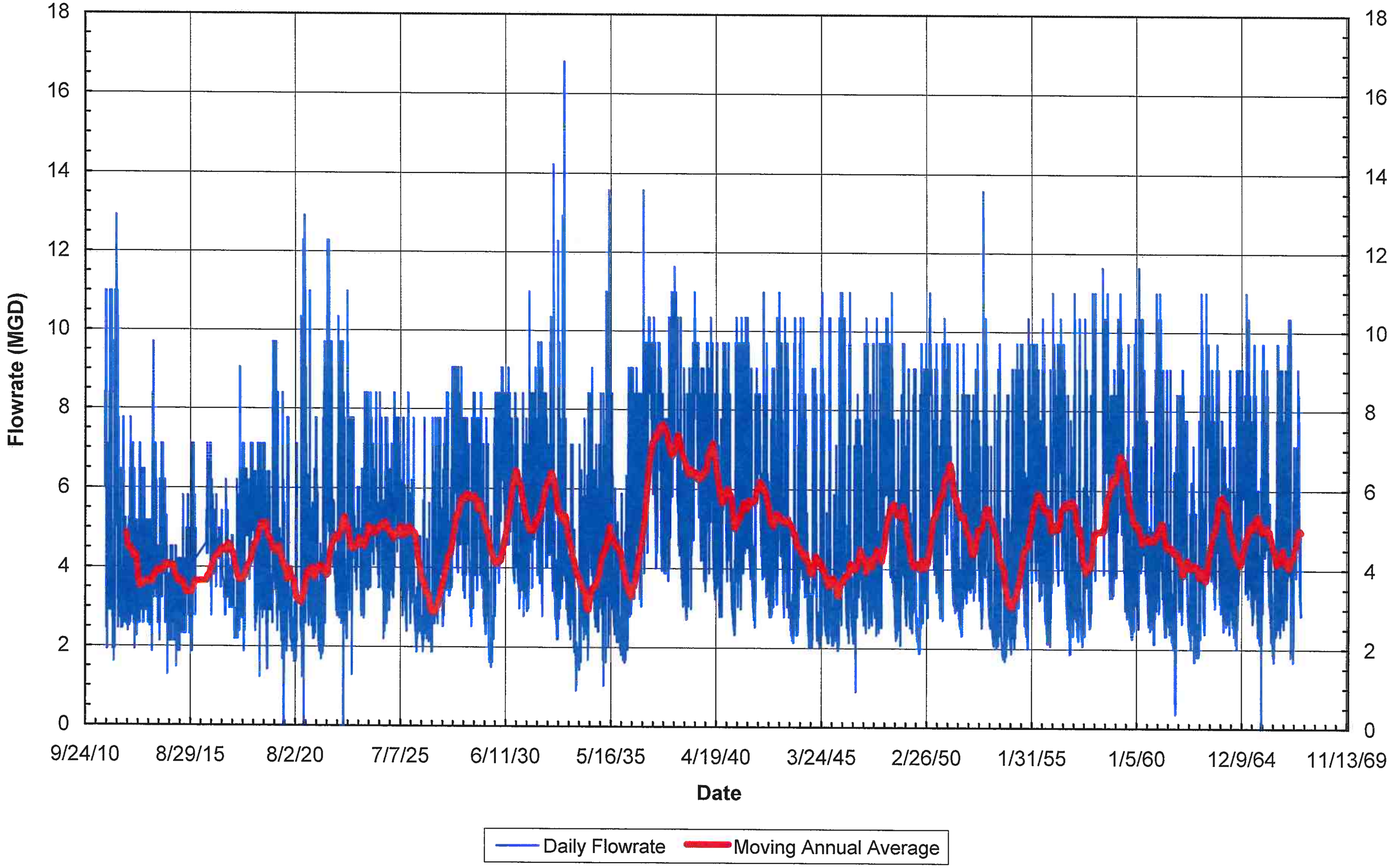


Figure 5. Duration-Discharge Characteristics of Olowalu Ditch at USGS Gage 6450 Based on 1911 to 1967 Daily Flowrates

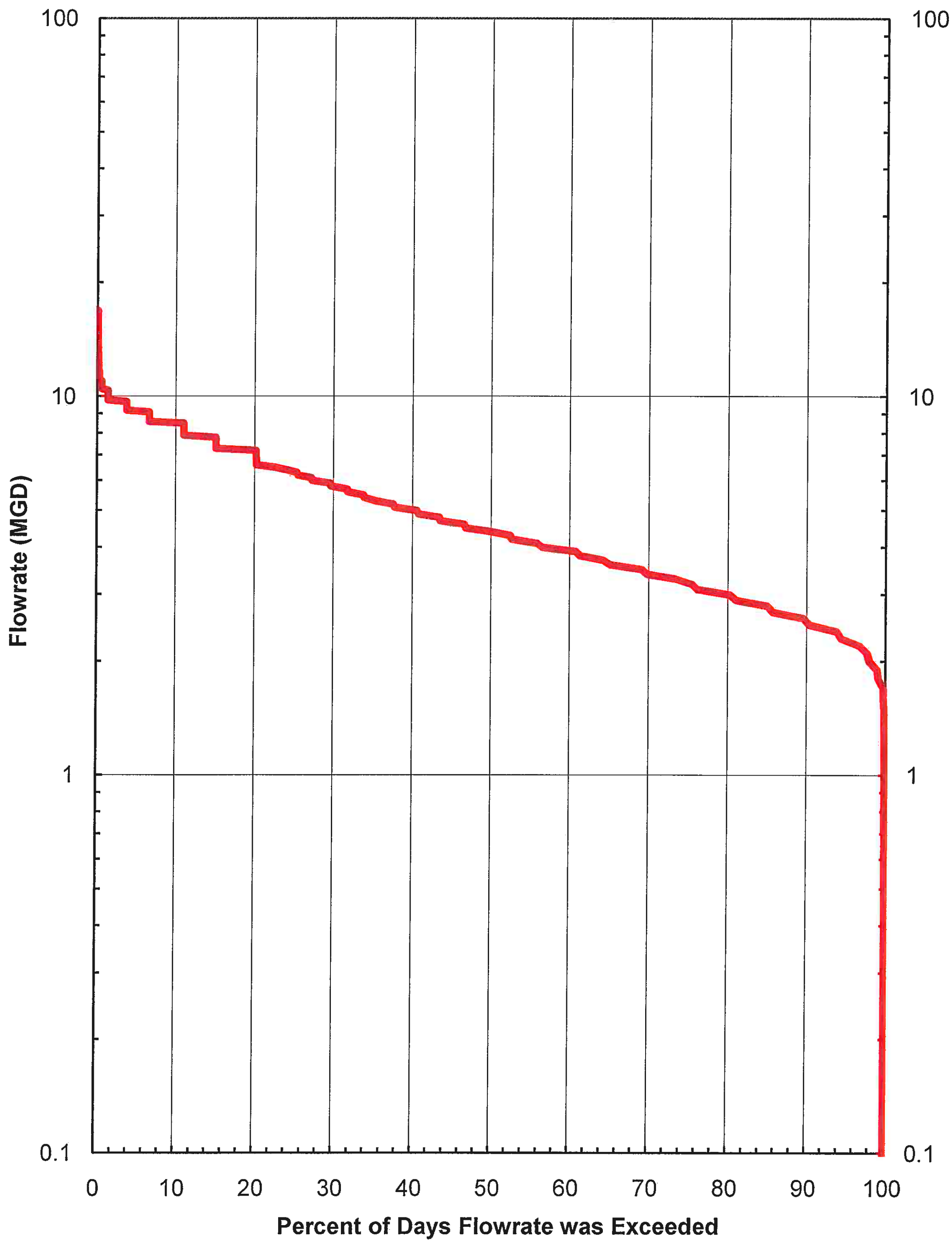


Table 1

Water Quality of Samples From Olowalu Wells and Olowalu Stream

Sample Location	Sample Date	Forms of Nitrogen				Forms of Phosphorus			Silica (µM)	Salinity (PPT)
		NO_3 (µM)	NH_4 (µM)	DON (µM)	TN (µM)	PO_4 (µM)	DOP (µM)	TP (µM)		
Olowalu-Elua Well	6-11-10	4.00	0.90	16.70	21.60	0.70	1.60	2.30	760	0.175
Olowalu-Elua Well	6-09-11	7.60	39.40	12.50	59.40	0.64	1.36	2.00	726	0.183
Olowalu Shaft - Pump N	6-11-10	34.40	2.10	2.80	39.30	3.30	1.70	5.00	844	0.294
Olowalu Stream at 520'	6-11-10	0.40	0.80	20.20	21.40	0.60	1.70	2.30	721	0.160
Olowalu Stream at 210'	6-11-10	0.20	0.80	22.40	23.40	0.40	1.50	1.90	698	0.177

<u>Notes</u>:
1. Samples collected by Tom Nance of TNWRE Inc.
2. Water quality analyses by Marine Analytical Specialists.
3. The symbol µM stands for micro-molar. To convert µM to milligrams per liter (mg/l), multiply by the atomic weight and divide by 1000.

water chemistry at the lower site was essentially identical to the upper one (Table 1), indicating that the water that had emerged into the stream was probably discharged from high level groundwater compartments.

Over a distance of a few hundred yards downstream of the lower diversion, all of the dry-period streamflow disappears into the streambed of boulders and alluvium. The USGS maintained a stream gaging station a little further makai where the stream is normally dry. Flowrates over the 1963 to 1967 common record period at the USGS' upper ditch and lower stream gages are illustrated on Figure 6. That record and the comparative duration-discharge curves on Figure 7 demonstrate that streamflow at the USGS gaging site is almost entirely freshets. There was no flow on 80 percent of the days. Streamflow reaches the shoreline to discharge into the marine environment, a distance of 4,000 feet from the USGS stream gage, on an even fewer number of days.

Groundwater Occurrence. In addition to the indicators of groundwater occurrence as discharge into Olowalu Stream, information on groundwater occurrence is provided by:

- Results of two high elevation development tunnels further back in Olowalu Valley (Well Nos. 5035-01 and 5134-01);
- Numerous mapped dikes [Plate 1 of Stearns & MacDonald, 1942 and Sheet 7 of Sherrod et al. (2007)];
- Pumpage records in Hatton (1976) of Pioneer Mill's Shafts "N" and "O" (Well Nos. 4937-01 and 4837-01, respectively) which tap basal groundwater; and
- Results of the Olowalu Elua Well (No. 4936-01) which was developed in 1999 and is the source of potable supply for PWS 209.

The lower of the two high elevation development tunnels was dug by Pioneer Mill in 1912 at elevation 775 feet and on the north side of the stream channel. Although located in an area of numerous dikes, it produced no flow (page 213 of Stearns & MacDonald, 1942). No other information on this tunnel is available. The upper tunnel is far back in the valley at 1710-foot elevation. The 3000-foot long tunnel produced only a modest flow (100,000 GPD), probably intercepting groundwater that otherwise would have discharged into the stream.

The two wells that tap basal groundwater on the property were developed by Pioneer Mill in 1905 (Well 4837-01, the "O" Pump) and 1933 (Well 4937-01, the "N" Pump). The older Well 4837-01 has four horizontal development tunnels and seven drilled wells in the tunnels. The more recent Well 4937-01 has one, 230-foot long horizontal development tunnel. Large capacity pumps were installed in both wells. Increased use in the 1970s caused significant salinity increases in both wells. At more modest rates of use, on the order of 1.0 MGD, both wells are capable of producing slightly brackish water suitable for supplemental irrigation use.

Figure 6. Olowalu Ditch and Stream Flowrates as Measured at USGS Gaging Stations Over their Common Period of Record, June 1963 through September 1967

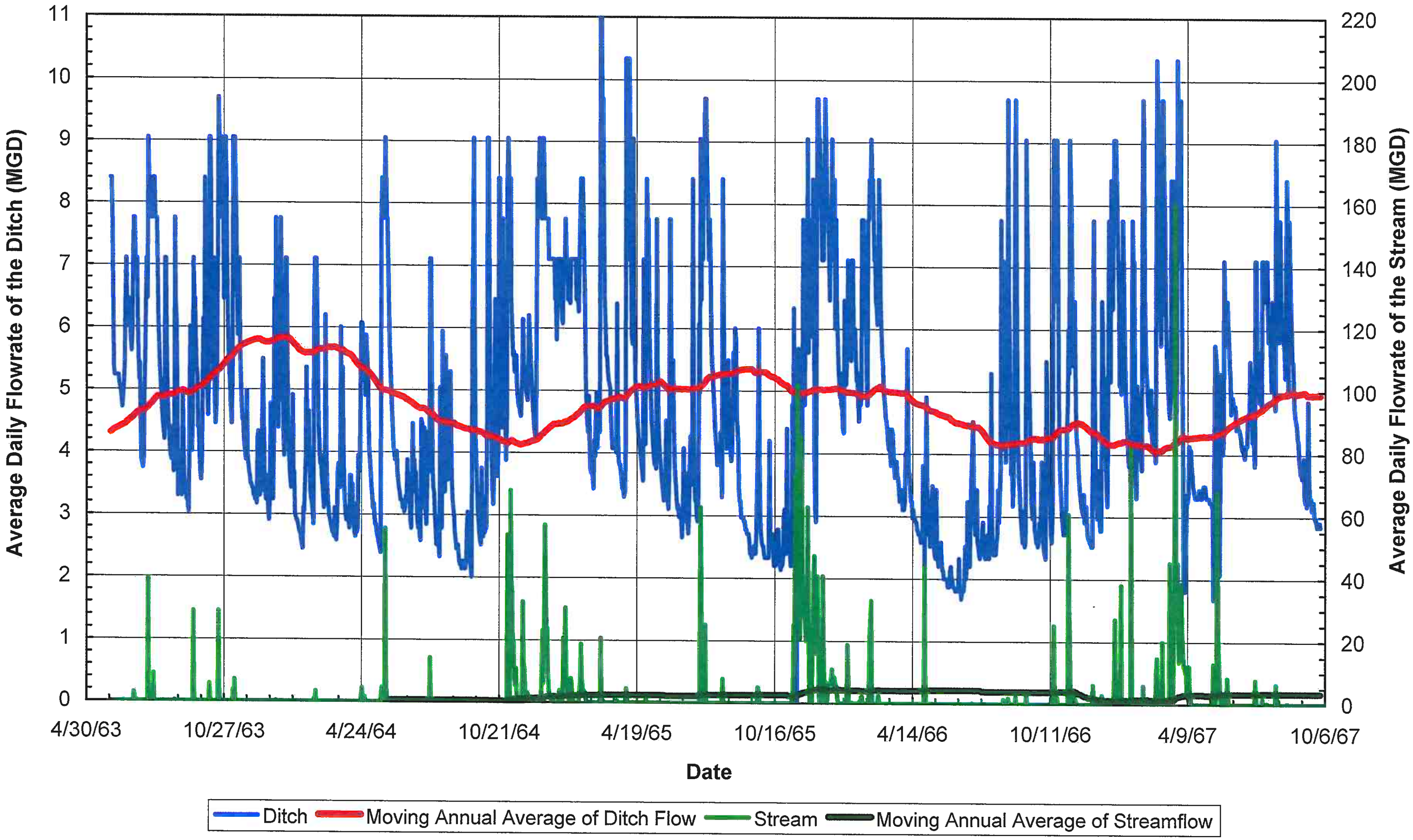
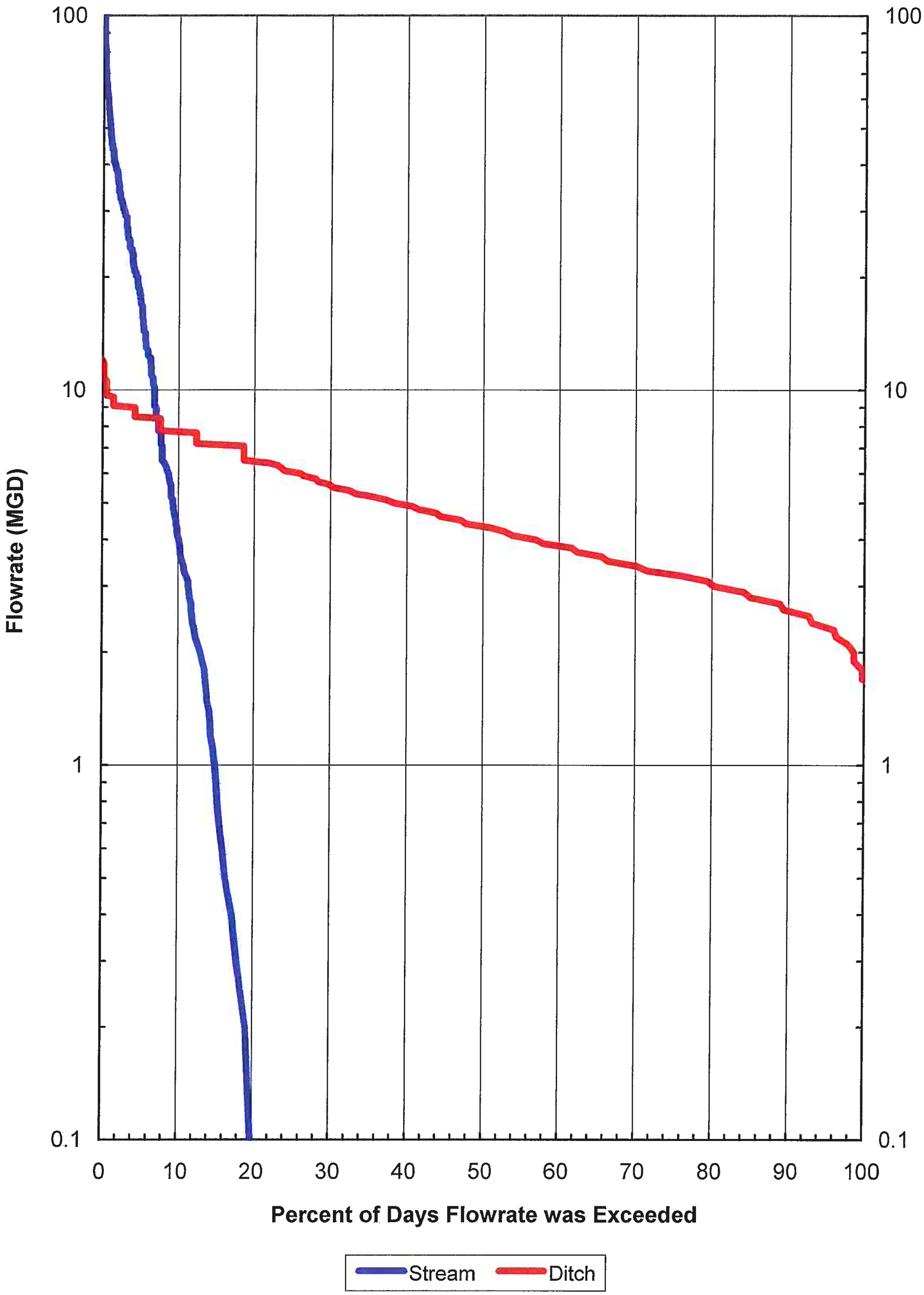


Figure 7. Comparison of Duration-Discharge Characteristics of Olowalu Ditch and Olowalu Stream, June 1963 to September 1967



Results of the Olowalu-Elua well, the sole drinking water source for PWS 209, are worthy of further discussion. It was initially assumed to tap into basal groundwater, but in retrospect, that may not actually be the case:

- Its water level is about two feet higher than Well 4937-01, an anomalous difference for basal groundwater over the relatively short distance between the wells.
- The driller reported that there was no water in the borehole until drilling reached 10 feet below sea level [Well Completion Report on file at the State Commission on Water Resource Management (CWRM)].
- Its semi-diurnal water level variations are barometric rather than tidal.
- Its very low and unchanging salinity in response to pumping (chlorides of 20 MG/L) are anomalous for basal groundwater at this location, particularly in comparison to basal Well 4937-01.
- Its water chemistry, at least for the limited number of parameters tested for this assessment, is essentially identical to the streamflow maintained by high level groundwater discharge (refer back to Table 1).

Whether the well taps a high level groundwater compartment or simply a portion of the basal aquifer where leakage of high level groundwater is the primary source of recharge is not known. In either case, however, the well's consistently low salinity is substantially better than would otherwise be expected in this location.

Estimates of Impacts on Water Resources

Existing Conditions. To create a baseline of existing conditions against which the changes due to the project's development will be compared, the following flowrates have been assumed:

- Discharge of Groundwater Along the Project's Shoreline. Using the State CWRM's methodology for establishing the sustainable yield of the Olowalu Aquifer System, groundwater discharging along the Olowalu Town project's shoreline is approximated as seven (7) MGD. A more recent and sophisticated groundwater recharge study by the U.S. Geological Survey (Engott and Vana, 2007) indicates that the groundwater flowrate may be as much as 16 MGD. However, the lower (and more conservative) flowrate is used for the assessment of impacts herein.
- Surface Runoff to the Shoreline. Streamflow at USGS Gage Station 6462 averaged 2.34 MGD over its 10-year period of record (June 1963 to September 1973). This gaging station is 4000 feet from the shoreline, meaning that losses along the section of the streambed downgradient of

the USGS gaging station reduce the amount of actual shoreline discharge. However, there is also runoff from other areas of the project site which offset the seepage loss in the nearshore Olowalu streambed. As a first order approximation, it is assumed that existing surface runoff to the shoreline averages 2.3 MGD year-round and that 85 percent of this occurs at the point of shoreline discharge of Olowalu Stream. The remainder represents about one-third of the 20 inches of annual rainfall on the 635-acre project site.

Project Water Uses and Wastewater Generation. Table 2 presents estimates of potable and non-potable water uses by land use category at the project's full build-out. It also presents estimates of the amount of R-1 treated wastewater that will be available for irrigation reuse. Several aspects of these estimates should be noted:

- The amounts in Table 2 are year-round averages at full build out.
- The water use and wastewater generation amounts are, in every case, less than design numbers for each land use as presented in the project's engineering reports (Otomo, 2011 and Brown and Caldwell, 2011). The numbers in the table are the expectable actual use amounts. The design numbers in the two engineering reports, which are the basis for sizing infrastructure, by definition are conservative. If they do not exceed actual use, the infrastructure would be undersized.
- The treated R-1 effluent available for irrigation reuse is generally estimated at 85 percent of the within-building potable water use. The remaining 15 percent would be lost in conveyance hardware, lost to evaporation and leakage at the wastewater treatment plant, or simply not be discharged into the wastewater system at the points of use.
- About 100 acres in four land use categories (Public/Quasi Public, Park/Open Space, Agriculture, and the relocated State Highway) have been identified for the irrigation reuse of the R-1 treated wastewater (Brown and Caldwell, 2011). At full build out, it is estimated that about 0.24 MGD of the R-1 effluent would be used for this irrigation. The remainder, ultimately amounting to 0.14 MGD, would be directed into the two-acre constructed wetlands and then disposed of in the 4.7-acre leach field.

Estimated Changes to the Amount and Quality of Groundwater Discharging Along the Project's Shoreline. Based on expected water use and wastewater generation amounts, Table 3 presents the estimated changes to groundwater flowrate and the loading of nitrogen and phosphorus that would ultimately reach and be discharged along the project's shoreline. The series of assumptions and calculations incorporated into this table are as follows:

- Concentrations of nitrogen and phosphorus in groundwater presently discharging along the project's shoreline are the same as in Well 4937-01 (Pioneer's "N" Pump) as shown in Table 1.

Table 2

Projected Potable and Non-Potable Water Use and
R-1 Treated Wastewater Effluent Available for Irrigation Reuse

Land Use	No. of Units	Area (Acres)	Potable Water Use		Non-Potable Water Use		R-1 Treated Wastewater Effluent	
			Unit Use Rate (GPD / Unit)	Amount (GPD)	Unit Use Rate (GPD / Unit)	Amount (GPD)	Unit Amount Rate (GPD / Unit)	Amount (GPD)
SF Residential								
• Served by Dual System	500	--	275	137,500	275	137,500	235	117,500
• Served Only by Potable System	400	--	550	220,000	--	--	235	94,000
MF Residential								
• Served by Dual System	430	--	225	96,750	175	75,250	190	81,700
• Served Only by Potable System	150	--	400	60,000	--	--	190	28,500
Commercial	375,000 ft^2	24	1,200	28,800	800	19,200	1,020	24,480
Public / Quasi-Public	--	25	1,200	30,000	800	20,000	1,020	25,500
Park and Open Space	--	75	250	18,750	2,500	187,500	200	15,000
Conservation	--	75	--	--	1,500	112,500	--	--
Agriculture	20 Lots	30	275	5,500	2,500	75,000	235	4,700
Highway and Interior Roads	--	50	--	--	500	25,000	--	--
Totals	1,500			597,300		651,950		391,380

Table 3

Projected Changes in the
Groundwater Discharged Along the Project's Shoreline

I t e m	Flowrate (MGD)	Nitrogen (lbs/day)	Phosphorus (lbs/day)
Existing Conditions	7.0	32.07	9.04
Drafts From Groundwater			
• For the Potable System	0.60	1.539	0.333
• Brackish Supplement to Non-Potable System	0.02	0.092	0.026
Total Drafts From Groundwater	0.62	1.631	0.359
Returns to Groundwater			
• Irrigation Return of Potable Water	0.014	0.652	0.016
• Irrigation Return of Brackish Groundwater	0.002	0.095	0.002
• Irrigation Return of Surface Water	0.039	1.862	0.046
• Irrigation Return of R-1 Effluent	0.024	0.054	0.008
• R-1 Effluent of Leach Field	0.126	2.099	0.210
Total of Returns to Groundwater	0.205	4.762	0.282
Post-Development Projected Condition			
• Amounts	6.585	35.201	8.963
• Percent Change	5.9% Decrease	9.8% Increase	0.9% Decrease

- Nitrogen and phosphorus in groundwater pumped for the potable system will be the same as in the Olowalu-Elua well, also in Table 1.

- The treated R-1 effluent will have a total nitrogen (TN) concentration of 10 mg/l or less and total phosphorus (TP) of 5 mg/l or less (Brown and Caldwell, 2011). For the calculations herein, it is assumed that average concentrations are 80 percent of these upper limits.

- For the 0.24 MGD of R-1 effluent reused for irrigation, it is assumed that its dissolved nitrogen and phosphorus are sufficient for plant growth, meaning that no fertilizer would have to be applied in these areas. This has proven to be the case in other R-1 irrigation applications.

- Of the 0.65 MGD of total non-potable water use, 0.24 MGD would be R-1 effluent, 0.39 MGD would be surface water supplied by the Olowalu Ditch, and 0.02 MGD (as a year-round average) would be a periodic supplement by Well 4937-01.

- In areas of landscape irrigation by sources other than the R-1 effluent, fertilizer would be applied at an average for nitrogen of three (3) pounds per 1000 square feet per year. Phosphorus would be applied at 0.5 pounds per 1000 square feet per year.

- For all landscape irrigation regardless of source, 10 percent of the applied water passes below the plant root zone to groundwater below. It carries with it 10 percent of the applied nitrogen and five percent of the applied phosphorus.

- For the 0.14 MGD of R-1 effluent that is directed to the two-acre constructed wetlands, 10 percent is lost to evaporation and the remaining 0.126 MGD is disposed of in the 4.7-acre leach field. In passage through the wetlands half of the nitrogen and phosphorus are taken up in plant growth.

- For all uses of water for which a portion is ultimately returned to groundwater as excess applied landscape irrigation or leach field disposal, natural processes will reduce the nutrient loading. These processes take place during the downward passage through the vadose (unsaturated) zone and lateral movement in groundwater to the shoreline. Nitrogen removal, primarily by denitrification, is assumed to be 75 percent. Phosphorus removal, primarily by adsorption, is assumed to be 90 percent. Based on admittedly limited available data, these assumptions appear to be conservative.

In round numbers, the end result of the series of assumptions and calculations incorporated into Table 3 are a reduction by six (6) percent of the groundwater flowrate discharged into the marine environment, a 10 percent increase in the amount of nitrogen, and a one (1) percent decrease in phosphorus.

Projected Use of Groundwater versus the Regulatory Sustainable Yield of the Olowalu Aquifer System (60205). Present use of groundwater in the Olowalu Aquifer Sector is exclusively the water drawn by the Olowalu-Elua well (4936-01) to supply PWS No. 209. As shown on Figure 3, this is approximately 0.055 MGD as a year-round average. As projected herein, additional groundwater use for the Olowalu Town Master Plan project would be 0.60 MGD for potable use (Table 2) and on the order 0.02 MGD of brackish water from the N and/or O Pump wells previously used by Pioneer Mill. This would increase the ultimate use of groundwater to about 0.7 MGD.

The CWRM is the State agency which regulates the use of groundwater. In its 1990 Water Resources Protection Plan (George A.L. Yuen and Associates, 1990), it set sustainable yields for all aquifer systems in the State. For the Olowalu Aquifer System, it initially set its sustainable yield at three (3) MGD based on: (i) recharge to groundwater on the order of 4 to 7 MGD; (ii) the assumption of all of the developable supply is basal groundwater with an initial head [ie. water level] of 5 feet; and (iii) an analytical method that, for the basal groundwater conditions assumed, calculated that 44 percent of the aquifer's recharge can be developed as its sustainable yield. In 2008, the CWRM issued the final version of its updated Water Resource Protection Plan (Wilson Okamoto Corporation, 2008). In it, the sustainable yield of the Olowalu Aquifer System was reduced from three (3) to two (2) MGD using the lower end of the estimated aquifer recharge (Table 3-10 on page 3-65 of Wilson Okamoto Corporation, 2008). Projected future groundwater use of 0.7 MGD by existing users and the addition of the Olowalu Town project would still be substantially below this lowered, sustainable yield amount.

Recharge calculations utilized by the CWRM for the Olowalu Aquifer System are based on annual averages (measured and estimated) of rainfall, surface runoff, and evapotranspiration (ET). In relatively dry areas such as Olowalu, the use of annual averages to compute recharge often results in an overestimate of ET and a resulting underestimate of recharge and the sustainable yield. The more sophisticated and detailed recharge calculations in Engott and Vana (2007) illustrate this. Using a daily time step method of computation, it calculated the recharge of the Olowalu Aquifer System to be 16 MGD (Table 14, page 43 of Engott and Vana, 2007). Using the CWRM's methodology to derive the sustainable yield from recharge, the USGS study suggests that the Olowalu Aquifer System may have a developable supply on the order of seven (7) MGD.

Estimated Changes to the Amount and Quality of Surface Runoff Discharged From the Project's Shoreline. There are two aspects of surface runoff to assess, the use of Olowalu Ditch and the changes to rainfall-runoff. It has previously been estimated that the project would use an average of 0.39 MGD from the ditch. The ditch flow is now measured at a location close to the system's storage reservoir and about 1.1 miles downstream from the point of stream diversion. As observed on June 11 and 26, 2010, water diverted from the stream and into the ditch was visually estimated to be about 2.0 MGD. The flowrate recorded prior to discharge into the open storage reservoir was less than 0.9 MGD. The difference was lost to leakage in transit, with essentially all of that leakage returning back to the stream and ultimately disappearing into the streambed below 200-foot elevation.

Currently during low flow periods, all of the Olowalu Ditch flow is used for various ongoing irrigation uses or is lost in the irrigation system's distribution network. In order for the ditch system to provide the estimated 0.39 MGD for the Olowalu Town project, it will be necessary to make repairs to Olowalu Ditch and the distribution system and to institute an appropriate maintenance program. This more efficient use of water diverted from Olowalu Stream will not create a significant difference in surface water discharge at the shoreline by Olowalu Stream.

Present surface runoff from the project's 635-acre area was previously estimated as one-third of its 20 inches of annual rainfall. This is equivalent to 0.31 MGD as a year-round average. The project's retention basins are to be designed to keep post-development peak rates and volumes of stormwater runoff the same or less than existing conditions during a 100-year, 24-hour design storm. The installed retention volumes for this hypothetical design storm will have a more substantial impact on smaller rainfall events, meaning that the actual surface runoff from the project site may actually be less than under the existing, undeveloped condition. Since it is virtually impossible to estimate that reduction for the spectrum of actual rainfall-runoff events that will occur, it is simply assumed that there will be no increase in surface runoff discharge along the shoreline as a results of the project's development.

Water quality data of surface runoff from developed areas are scarce and widely varying. In general, these data indicate that nitrogen and phosphorus levels in stormwater runoff are lower than background levels in groundwater. On this basis and as an order of magnitude estimate, it is assumed that increases of 30 μM of nitrogen and 2 μM of phosphorus in surface runoff from the project site and discharged at the shoreline will occur. For an average discharge of 0.31 MGD, the increased loading would amount to 1.08 pounds per day of nitrogen and 0.16 pounds per day of phosphorus. Together with the groundwater charges presented in Table 3, the nitrogen increase over existing conditions would be 13 percent and the phosphorus increase would be about one (1) percent.

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