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IN REPLY REFER TO:

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

February 1, 2017

The Honorable Ronald D. Kouchi,
President and Members of the Senate
Twenty-Nineth State Legislature
State Capitol, Room 409
Honolulu, Hawaii 96813

The Honorable Joseph M. Souki,
Speaker and Members of the House of Representatives
Twenty-Nineth State Legislature
State Capitol, Room 431
Honolulu, Hawaii 96813

Dear President Kouchi, Speaker Souki and Members of the Legislature:

For your information and consideration, I am transmitting a copy of the Water Scalping Report as requested in ACT 229(15).

In accordance with HRS 93-16, I am also informing you that the report may be viewed electronically at: http://hidot.hawaii.gov/library/reports/reports-to-the-legislature/

Sincerely,

FORD N. FUCHIGAMI
Director of Transportation

CC: Legislative Reference Bureau

PRELIMINARY REPORT

Feasibility Study on the Use of Water Scalping Technology at Honolulu International Airport, Kahului Airport, Kona International Airport at Keahole and Hilo International Airport

Prepared for

State of Hawaii
Department of Transportation
Airports Division

January 2017

CH2M HILL, Inc.
R.M. Towill Corporation

Project No. ES1919-16
AIP No. 3-15-0000-008

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Acronyms and Abbreviations

A&B	Alexander and Baldwin
ARFF	Aircraft Rescue Fire Fighters
BOD	Biochemical Oxygen Demand
CC	Central Concourse
CCH	City and County of Honolulu
COC	Cycles of Concentration
CONRAC	Consolidated Rental Car Facility
DLNR	Department of Land and Natural Resources
DOT-A	Department of Transportation-Airport Division
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FDC Honolulu	Federal Detention Center, Honolulu
FM	force main
ft	feet
FY	fiscal year
gpm	gallon per minute
HAR	Hawaii Administrative Rules
HDOH	State of Hawaii Department of Health
HDOT	State of Hawaii Department of Transportation
HNL	Honolulu International Airport
HP	horsepower
IICC	International In-flight Catering Company
ITO	Hilo International Airport
kgal	thousand gallon
KOA	Kona International Airport at Keahole
M	million
MBR	membrane bioreactor
mg/L	milligram per liter
MG	million gallon
MGD	million gallons per day
O&M	operations and maintenance
OGG	Kahului Airport
ppm	parts per million

QTA	Quick-Turn-Around
RO	reverse osmosis
TDH	total dynamic head
TDS	total dissolved solid
TSS	total suspended solids
UIC	Injection Control Program
USGS	United States Geological Survey
V	volt
WRF	Wastewater Reclamation Facility
WWPS	wastewater pump station
WWRF	wastewater reclamation facility
WWTP	wastewater treatment plant

SECTION 1

Introduction

This preliminary study looks into the feasibility of water scalping technology at four State of Hawaii airports: Kahului (OGG), Kona (KOA), Hilo (ITO), and Honolulu (HNL), as authorized by Act 229 in 2015 by the Hawaii State Legislature. Water scalping involves the extraction and/or processing of sewage and wastewater so that it may be put to beneficial use, such as for irrigation. This study will eventually recommend specific airport facilities or areas where scalping technology should be deployed, the net benefit of using water scalping technology, cost estimates, and practicality for such a deployment, and if funds are available, design scope of work for each airport. This report provides the initial findings and recommendations that could prove beneficial for each specific airport. Further data collection and analyses are planned to finalize this report.

1.1 Alternative Water Sources and Treatment Technologies Available for Offsetting Potable Water Usage

1.1.1 Wastewater Mining and Scalping

One method of producing reclaimed water is to "mine" or "scalp" water from wastewater sources. If the wastewater source is fairly constant, a scalping wastewater treatment plant (WWTP) can be installed to create a source of water. With the development of automated package plants, in particular plants that employ membrane bioreactor (MBR) technology, they are able to scale to fit the available flow.

The MBR uses a membrane in lieu of a clarifier in an activated sludge process to separate water from the biomass in an activated sludge process. This physical barrier, which has a pore size smaller than the bacteria in the process, produces a high quality effluent that is well suited for producing reclaimed water. While many are focused on the liquid side of the process, the solids produced must also be addressed. The biomass must be periodically wasted to maintain a proper sludge age, which is important to keep a diverse population in the biomass. The solids that are wasted must be dealt with. Four general options for addressing the solids include the following:

- Option 1: Holding and periodically hauling to another facility for processing.
- Option 2: Aerobically digesting the biomass to reduce the volume and then haul to another facility for final processing.
- Option 3: Aerobically digesting the biomass to reduce the volume and then dewatering followed by disposal.
- Option 4: Returning screenings and biomass to a suitable wastewater main.

Many small wastewater plants opt for Option 1 because the volume of solids may not warrant a solids handling facilities. Option 2 can be implemented if the haul distance is large. Option 3 is full scale solids treatment and handling. Option 4 is ideal if a wastewater main is within close proximity (such as the wastewater main that provides the source of raw wastewater feeding the scalping plant). The solids would flow to the treatment plant along with the sewage. This would require an odor analysis to ensure that the addition of the solids would not cause odor issues between the disposal site and the treatment plant. Wastewater flow in the sewer must also be sufficient to keep discharged solids from the scalping plant in suspension, to avoid solids deposition and pipe constraints.

Depending on the final use of the scalped and treated wastewater, demineralization may be required. If reverse osmosis is required for this demineralization, then the filtration process must be a membrane filtration rather than a granular-media filtration. If electrodialysis reversal is used, granular media filtration is acceptable.

Important regulatory considerations for using a scalping plant or polishing plant include the following:

- All wastewater systems should be designed, constructed, operated, and maintained in accordance with Hawaii Administrative Rules (HAR) 11-62. Treatment works' effluent and other parameters for recycled water are to be monitored and not exceed the limits in HAR 11-62-26.
- In July 2015, House Bill Number 1394 put forth a water scalping feasibility study and pilot project that is expected to be completed in 2019, and will likely influence regulatory standards related to the water scalping plant implementation and operation.

1.1.2 Storm Water and Rainwater Capture for Water Reuse

Storm water and rainwater catchment are feasible to varying degrees at each of the four airports, depending on a number of factors that are unknown at this phase in the study. The following section summarizes current knowledge on general water catchment, storage, treatment, and reuse options for storm water and rainwater that may be applied to a number of the airports once feasibility can be determined with greater certainty.

1.1.2.1 Storm Water and Rain Water Harvesting

As water-short areas assess long-term planning needs for new supplies of potable water, municipalities and organizations around the world are turning increasingly toward the primary source: rainwater and the resulting storm water. Rainwater quality is typically low in minerals and pathogens, and is suitable with conditioning for a wide range of uses. Besides functioning as a supplemental source of potable water, harvested rainwater offers the potential to augment current potable water supplies for water uses such as irrigation and wash water, thereby allowing existing main water supplies to be prioritized for potable use. Also, capture of rainwater can reduce drainage flow and pollutant loads from a watershed to help reduce flooding and to protect the quality of sensitive receiving waters. While individual weather events may be challenging to predict, the typical seasonality of rainfall and long-term precipitation records provides a planning basis sufficient to estimate the usable volume and supply reliability.

Rainwater can be implemented on a wide range of scales from buildings to watersheds. As a technology, rainwater harvesting has been practiced for over 4,000 years (GDRC, 2002). However, with recent renewed interest in sustainability, as typified by the Millennium Development Goals, rainwater harvesting has begun to be more commonly explored when planning or implementing new development (MilleniumProject, 2005). For example, Singapore harvests rainwater from the roofs of high-rise residential buildings to defray the cost of water pumping, while rainwater harvested at Changi Airport is used for fire-fighting drills and toilet flushing (UNEP, 2016). In Hawaii, planning guidance developed in 2008 reflected this interest and offers examples and approaches to implementing rainwater and storm water harvesting (Commission on Water Resource Harvesting, 2008).

Besides estimating volume and reliability, the capture, storage, conveyance, and treatment are typical components of a rainwater harvesting concept. Solutions are typically found to be site-specific based on an understanding of the opportunities balanced against site constraints.

1.1.2.2 Storm Water Capture for Water Reuse

Storm water may be a potential source of reuse water depending on the quantity and quality of this water. Harnessing storm water during high precipitation and discharge events would reduce dependence on potable water for non-potable activities. The quantity available likely fluctuates by the region and season, and further hydrological storm water flows and historical precipitation data would support decisions regarding available quantity for use. In addition, to determine the availability of storm water flows, a streamflow impact assessment would be necessary to ensure that diverted flows for reuse would not have negative effects downstream. Storm water runoff capture is recognized by the U.S. Environmental Protection Agency (EPA) as a low impact development and green infrastructure technique to reduce peak flows and enhance contaminant removal in storm water flows (Blackwell, 2013). The San Diego International Airport is currently developing methods for capturing and reusing storm water for non-potable airport operations and the Melbourne International Airport has been collecting and reusing storm water since 2012.

1.1.2.3 Storm Water Treatment and Storage

If quantity and quality of storm water are feasible for use, storm water from drainage channels, airport landing sites, parking lots, and others, could be diverted for treatment and storage before use. After treatment, the water should be stored in underground cisterns or in covered aboveground tanks. Aboveground tanks should be covered to minimize contamination, as well as to remove a potential habitat for bird populations that could cause increased strike potential with aircraft.

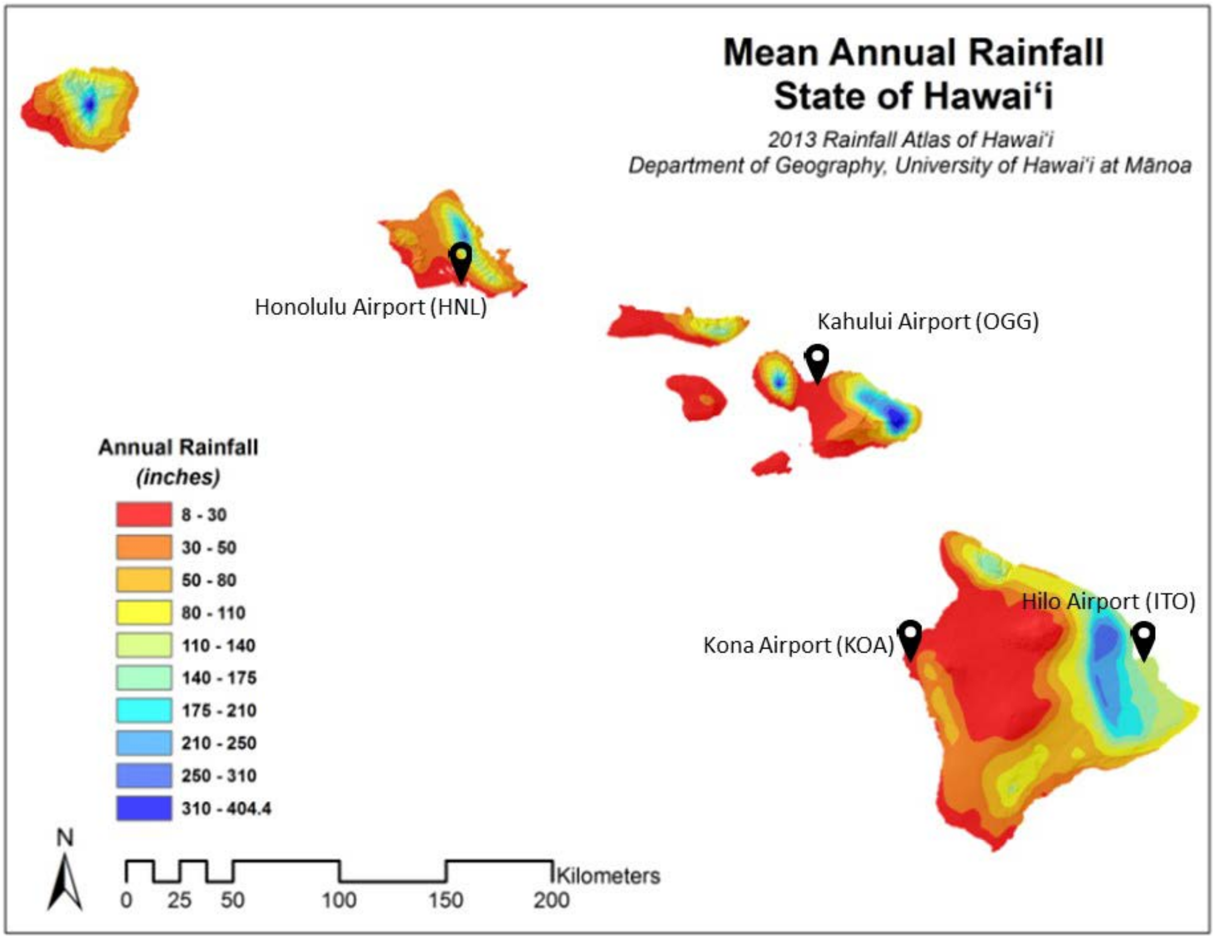
Collecting storm water from ground-level runoff surfaces typically introduces a wider range of contaminants compared to roof-based water collection. Common storm water contaminants include nutrients such as nitrogen and phosphorus, petroleum hydrocarbons, metals, synthetic organics, and pathogens. The treatment required for storm water is dependent on the intended reuse application of the storm water. A number of treatment guidelines depending on uses are outlined in the *Best Management Practices Handbook* by the State of Hawaii Commission on Water Resource Management (2008).

For example, hydrodynamic treatment devices can use storm water flow to remove solids and particulate contaminants in storm water as an add-on to existing storm water infrastructure. Groundwater recharge options such as excavated basins and infiltration trenches require little treatment. For uses that pose a possibility for human contact, storm water should be filtered and disinfected before reuse.

1.1.2.4 Rainwater Capture for Water Reuse

One of the greatest drivers to collect rainwater is its low cost and exceptional water quality. In general, roof-based rainwater has zero hardness, a neutral pH, and is sodium-free. These attributes provide a wide range of rainwater reuse opportunities for non-potable water activities at airport facilities. The feasibility of rainwater catchment systems depends greatly on the anticipated rainfall of the region. For Hawaii, annual precipitation can vary dramatically amongst islands and regions. Figure 1-1 shows the mean annual rainfall in the state of Hawaii (Giambelluca et al., 2013).

Figure 1-1. Mean Annual Rainfall in Hawai'i
(Giambelluca et al., 2013)



While the regions of three of the four airports receive the lowest category of annual rainfall (8 to 30 inches per year), this does not equate to infeasibility of rainfall catchment systems. Rainwater catchment systems were installed at the Austin-Bergstrom International Airport in Austin, Texas, where the average annual rainfall is 32.5 inches.

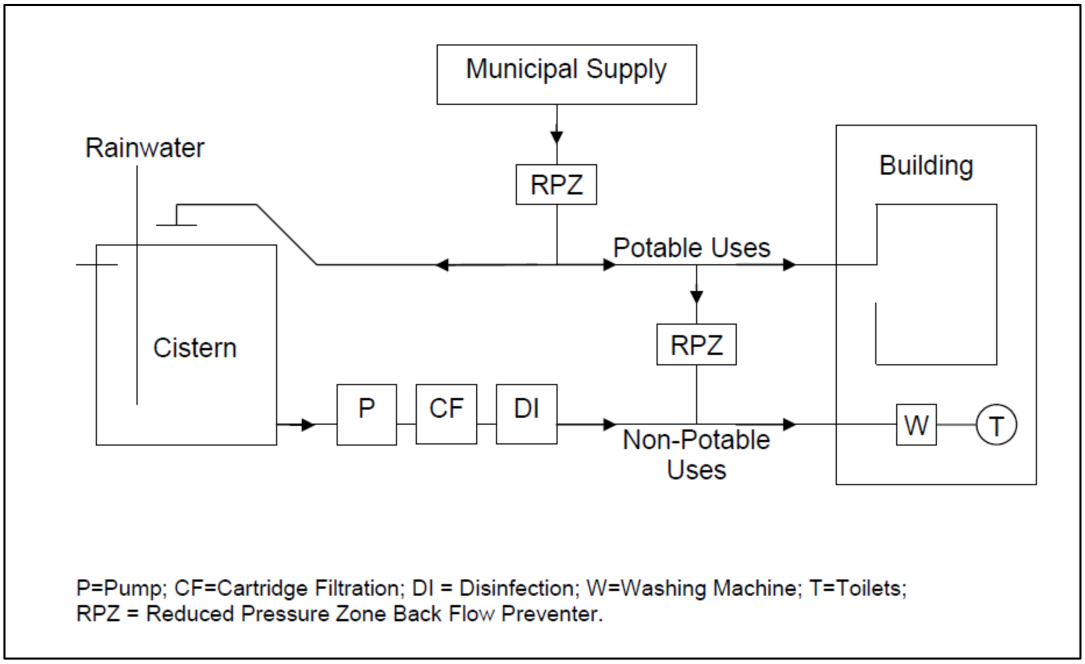
For every inch of precipitation that falls on a 1,000 square foot roof, approximately 623 gallons of rainwater can be captured. Using this principle, approximately 5,000 to 18,500 gallons per 1,000 square feet of roofing could be captured at HNL, OGG, and KOA. Approximately 87,000 to 109,000 gallons per 1,000 square feet of roofing could be captured at the ITO. However, these values do not include discarded rainwater from first flush diverters and water lost to pervious roofing materials. Further study would need to be undertaken to determine the efficiency and cost-benefit for rainwater harvesting at each of these locations.

1.1.2.5 Rainwater Treatment and Storage

Assuming that rainwater capturing is determined to be a feasible water reuse opportunity, the subsequent information provides guidance on rainwater treatment and storage. Rainwater treatment can start at the collection mechanism. First flush diverters can be used to divert the first few gallons of water to reduce impact from contaminants such as dust and bird droppings from the roof surface. Pre-filters can also be used to remove debris and any additional particulate matter from the rainwater. Various pre-filters are available for a wide range of system sizes, removal capacities and maintenance requirements. Some pre-filter options include pot-filters, basket filters, and cascade filters. These filters generally contain a filtration mechanism followed by an outlet that discharges into the rainwater collection tank.

A sealed leak-proof storage tank should be used to prevent contamination of the stored rainwater. Disinfection can be applied regularly using ultraviolet treatment or chlorine treatment at the storage tank. For rainwater systems used in conjunction with public water systems, a reduced pressure zone backflow preventer should be used to prevent cross contamination, and a backup potable water source that can be activated in place of rainwater is recommended, as shown in Figure 1-2 (Texas Rainwater Harvesting Evaluation Committee, 2006).

Figure 1-2. Rainwater in Conjunction with Public Water Supply
(Texas Rainwater Harvesting Evaluation Committee, 2006)

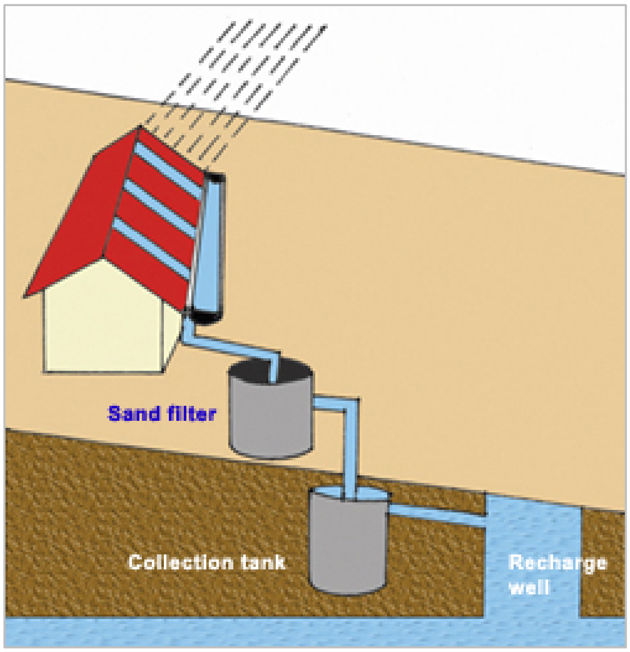


1.1.2.6 Storm Water and Rainwater Non-potable Uses

Non-potable uses of storm water and rainwater may depend on the seasonal availability and quantity of water that can be provided. However, storm water and rainwater can provide a number of uses as well as supplemental uses to enhance water reuse activities. Storm water and rainwater may be used for landscape irrigation, cooling tower make-up water, car wash facilities, washdown water, amongst other non-potable activities at the airports. Using storm water and rainwater as supplemental water sources during high precipitation months would reduce dependency on potable water for non-potable activities.

Smaller volumes of rainwater may be useful as a mixing water source for irrigation to reduce salinity in brackish water, and to dilute bacteria counts in storm water runoff. When mixed with brackish water, rainwater increases the overall water softness, reducing maintenance requirements on irrigation equipment because of scale build up. Storm water and rainwater capture for runoff management can also be used for groundwater recharge, and requires less robust treatment applications as shown in Figure 1-3 (CPR Environmental Education Center).

Figure 1-3. Rainwater Collection for Groundwater Recharge Diagram
(CPR Environmental Education Center).



1.1.3 Brackish Groundwater and Seawater Desalination

Desalination is the removal of dissolved minerals from saline or brackish water. Water is considered saline if the total dissolved solids (TDS) concentration is greater than 10,000 milligrams per liter (mg/L). There is no standard lower TDS limit for brackish water (generally it is between 1,000 and 3,000 mg/L); however, this study considers water to be brackish if the concentration is between 1,000 to 10,000 mg/L. Water is considered fresh if its TDS concentration is less than 1,000 mg/L; however, the EPA Secondary Drinking Water Standard is a maximum of 500 mg/L TDS.

If the supply is saline, the recommendation would be that the desalinated water be used for potable supply, rather than potential non-potable uses. The limits for certain minerals, such as boron and chloride in water, used for irrigation are often as low, or lower, than the limits required for potable water. So a treatment process of partial desalination to a higher TDS than required for potable use is likely not realistic for non-potable use for water used for irrigation. In addition, a larger desalination facility will have a better economy of scale. Therefore, the discussion of desalination options in this report will primarily focus on meeting the entire potable water supply of the airport, rather than offsetting the lower flow non-potable uses. Potable water will require compliance with all state and federal drinking water standards, as well as potential onsite storage. Desalination would provide a drought-proof and independent water supply. Blending of brackish groundwater with freshwater for irrigation is another feasible alternative.

There are several desalination treatment options available including thermal distillation, electrodialysis, and reverse osmosis (RO) among others. Thermal distillation processes are typically used only on saline waters, and electrodialysis is usually only practical on brackish waters. RO is the most widely used because of its competitive, if not lower overall cost, and physical barrier to microorganisms.

Seawater and groundwater are two potential sources for desalination supply. Seawater is saline, while groundwater can be fresh, brackish, or saline depending upon the location. Brackish water extraction is via groundwater wells, while seawater extraction can be via beach wells, or an open ocean intake. Beach wells extract filtered seawater to the desalination facility from below the surface near the shoreline, while open ocean requires an intake pipe/structure in the ocean. Desalination facilities treat the source water by separating it into a low TDS product water stream and a high TDS effluent waste stream. Disposal of the effluent is a challenge for these facilities as it must be discharged such that is does not become a point-source pollutant. Siting the intake and discharge structures must minimize environmental impact, energy consumption, and cost.

The effluent TDS will limit the disposal options. Brackish groundwater RO effluent or brine disposal options include deep groundwater injection or transporting to the local municipal sewer, and would be influenced by what is easier to permit. Injection wells will likely need to inject below the producing aquifer and there likely will be a substantial pressure required, (resulting in an increase energy demand for pumping), and higher operations and maintenance (O&M) costs. Statewide, injection wells must be located seaward (makai) of the Department of Health Safe Drinking Water Branch's Underground Injection Control Program (UIC) line. On the island of Oahu, injection wells must also be located makai of the Board of Water Supply's no-pass line. Saline source water RO effluents need to be sent to the ocean and are typically either diluted or diffused to protect aquatic life.

From an overall cost and intake perspective, groundwater desalination would be preferred over open intake seawater desalination. Brackish groundwater would have a lower TDS water than seawater, and save on both O&M and capital costs. Depending upon the source water quality and discharge requirements, potable water supplied via brackish groundwater desalination typically costs between \$500-\$1000 per acre-foot for facilities over five million gallons per day (MGD), not including effluent disposal. The "intake" required for groundwater desalination consists of well water extraction and conveyance to the desalination facility. Groundwater has the additional benefit of natural source water filtration in the aquifer. The desalination facility pretreatment requirements are lower, which reduces footprint and both O&M and capital costs. Because of this, even if the groundwater was seawater extracted via beach wells, the cost of groundwater desalination treatment would typically be lower than open intake seawater RO.

Much of the groundwater in Hawaii exists in a freshwater lens system, which includes a lens-shaped freshwater body, an intermediate transition zone of brackish water, and underlying saltwater hydraulically connected to the seawater. Therefore, studies are required to determine the optimal depth, and capacity of the brackish aquifer.

An optimal location for a seawater desalination facility is co-located with a power plant that uses seawater for once-through cooling. The power plant pumps the seawater through condensers to cool them, and remove waste heat from the system. The seawater will absorb this waste heat, and will typically flow back to the ocean via a separate discharge outfall.

With a co-located desalination facility, the power plant will already have the intake and discharge facilities permitted and constructed, and the desalination facility can simply collect a portion of the intake or return water from the cooling loop. This water will be pretreated before undergoing RO, and the fresh product water stream will be conveyed for potable supply, and the brine concentrate stream will blend with the remaining portion of the power plant return water which would dilute the effluent and lower the TDS before discharge to the ocean. According to the United States Geological Survey's (USGS's) Estimated Water Use in the United States in 2010, over 600 MGD of saline water is used in once-through cooling plants in the State of Hawaii. Further analysis is required to determine optimal power plants to co-locate with a desalination facility, but there is a large potential source available via this intake method. Co-locating has the added benefit of avoiding environmental issues with impingement or entrainment of aquatic life associated with a new ocean water intake. In some cases, co-locating also offers the benefit of lower power cost which is very important as seawater desalination is energy intensive.

Typically, the most difficult option to implement is new construction of an open (ocean) seawater intake and discharge. This requires coastal intake; discharge components, which can be expensive and complex in terms of permitting; and design to avoid impacts to marine life. Potable water supplied via seawater desalination typically costs over $2,000 per acre-foot for facilities producing over 5 MGD potable water. Smaller capacity plants would be more expensive because of economies of scale.

Currently, there are no large-scale seawater desalination facilities producing potable water in the state of Hawaii. There is a detailed pre-design of a large-scale groundwater facility on Oahu, and several small-scale groundwater desalination facilities online across the state. The environmental permitting process required for successful implementation of a seawater desalination facility can be difficult, particularly for an open ocean intake. Furthermore, the cost and complexity relative to other sources of potable water has prohibited its adoption in the state.

1.2 Hawaii Classification of Recycled Water Types

Hawaii currently uses guidelines with intent for the oversight of water reuse. The *Guidelines for the Treatment and Use of Recycled Water* (referred to as the Reuse Water Guidelines) was published by the State of Hawaii Department of Health (HDOH), Wastewater Branch (2002). Projects intending to use recycled water need to seek approval from HDOH.

The Reuse Guidelines address the technical requirements that must be met for R-1, R-2, and R-3 recycled water, as well as requirements to construct or modify a wastewater reclamation facility (WWRF).

The classification of recycled water is the following:

- **R-1**: Highest grade of recycled water; wastewater undergoes oxidation, filtration, and disinfection.
- **R-2**: The wastewater undergoes oxidation and disinfection.
- **R-3**: The wastewater undergoes only oxidation.

Honolulu International Airport (HNL)

HNL is the largest airport in the State of Hawaii and is owned and operated by the State of Hawaii Department of Transportation (HDOT). HNL has four active runways and serves 27 international and domestic carriers, three interisland airlines, and four commuter airlines. HNL has approximately 3.75 million square feet of terminal space and averages approximately 50,000 passengers per day. This section provides an overview of the current water/wastewater system at HNL.

2.1 Inventory of Water Use

HNL airport's water distribution system was supplied by three master meters: Aolele (2980 Aolele), Lagoon (463 Lagoon), and Paiea (530 Paiea). Water consumers (approximately 180 meter accounts) are served by water lines that form a loop along the airport perimeter. A map of the water distribution system is presented in Figure 2-1.

Historical master meter data for potable water were provided from 2009 to 2014 by month, as summarized in Table 2-1. These data indicated from 2009 to 2014, the average potable water consumption at HNL is 454 million gallons (MG) per year, or 1.24 MGD. The average water cost for the same time period is approximately $1.7 million (M) per year.

Legend

- Master Meter
- Potable Water Line

N

0 0.25 0.5 Miles

Imagery Source: ©2014 Google
Modifications have been made

Figure 2-1
HNL Water System
Honolulu International Airport
Honolulu, HI

ch2m

\\galt\Proj\HDOT\675792\MapFiles\Fig2-1_HNL_Water_System.mxd 1/11/2017 AESPEJO

Table 2-1. Historical Water Usage at HNL – Potable Water, in 1,000 gallons

	2009	2010	2011	2012	2013	2014
January	27,826	34,256	40,547	46,279	24,327	38,991
February	33,008	27,966	32,949	40,316	37,817	41,190
March	33,716	30,898	42,092	44,949	33,377	35,997
April	32,890	35,941	38,189	35,499	36,812	43,379
May	34,208	30,161	28,694	41,055	37,425	29,755
June	31,290	36,469	36,673	42,013	41,524	33,919
July	38,990	43,575	40,976	44,056	36879	33,976
August	33,393	34,478	40,155	42,727	38,545	35,654
September	32,797	41,467	41,574	52,395	46,401	38,014
October	31,643	35,709	44,762	68,394	38,510	34,481
November	35,952	43,270	42,075	35,827	41,061	35,326
December	34,256	34,652	37,700	47,802	44,232	30,378
Total	**399,969**	**428,842**	**466,386**	**541,312**	**456,910**	**431,060**
Average	**454,080**					

Non-potable water usage data was available for years 2009, 2013, and 2014, as summarized in Table 2-2. HNL does not pay for non-potable water.

Table 2-2. Historical Water Usage at HNL – Non-potable Water, in 1,000 gallons

Meter Location	2009	2013	2014
Aolele	45,704	49,609	52,554
Lagoon	1,259	7,034	5,351
Paiea	15,004	27,467	28,309
Total	**61,967**	**84,110**	**86,214**

Therefore, the total water consumption (potable and non-potable) from 2009 to 2014, is averaged at 492,795 thousand gallon (kgal)/year, or 1.35 MGD, as presented in Table 2-3. This represents an average of 26 gallons/passenger.

Table 2-3. Summary of Historical Water Usage at HNL, in 1,000 gallons

	2009	2010	2011	2012	2013	2014	Average
Potable	399,969	428,842	466,386	541,312	456,910	431,060	454,080
Non-Potable	61,967	--	--	--	84,110	86,214	--
Total	**461,936**	**428,842**	**466,386**	**541,312**	**541,020**	**517,274**	**492,795**
No. of Passenger	18,171,937	18,443,873	18,043,203	19,293,941	19,706,718	19,575,195	--
Gal/passenger	**25.4**	**23.3**	**25.8**	**28.1**	**27.5**	**26.4**	**26**

Note:

-- = Data unavailable

HDOT provided historical water meter readings at HNL during the period of January 2001 to August 2016, for all the sub-meters that served each individual water consumer. Cumulative meter readings were taken monthly at each meter location and water usage for the month was then calculated by subtracting the meter reading of the previous month from the current month.

A summary of potable water usage data is provided in Table 2-4. Table 2-4 ranked all the meter locations by the highest average potable water usage for the most recent 12 months (September 2015 to August 2016) for all sub-meters. Based on the historical water billing data for the last 12 months, the average water consumption across the HNL system was calculated to be 15,821 MG/month, or 0.53 MGD, as presented in Table 2-4. The difference between the master meter and sub-meter values is the nonrevenue water or unaccounted-for water, which could be caused by one of the following:

- Physical losses because of system leakage.
- Administrative losses because of illegal connections and under-registration of the water meters.

The 2016 HNL sustainable report, *2014 Elements Baseline - Update Year 5 Sustainability Categories Update: Energy, Carbon, Water, and Waste*, by HDOT and KYA Sustainability Studio, stated that water management at HNL continues to face challenges, including:

- Lack of an automated management and control system to remotely track detailed performance.
- Metering and management of tenant spaces.
- Unknown condition and location of all potable water infrastructures.
- Unknown volume of wastewater generated and the quantity of storm water.
- Distinction of actual water consumption versus leaks is unknown without an effective leak detection program.

The data presented in Table 2-4 indicates the largest water users at HNL are the Department of Transportation – Airport Division (DOT-A) Central Concourse (CC) chill tower, DOT chiller plant CP1, Federal Prison-High (Federal Detention Center Honolulu [FDC Honolulu]), International In-flight Catering Company (IICC), and Gate Gourmet.

Table 2-4. Summary of Water Usage at HNL – Sub-meters, in 1,000 gallons

Rank	Meter No.	Tenant	Aug-16	Jul-16	Jun-16	May-16	Apr-16	Mar-16	Feb-16	Jan-16	Dec-15	Nov-15	Oct-15	Sep-15	12-Month Average	Note
1	70251644[a]	DOT-A CC Chill Tower	6,372	0	4,853	0	11,546	0	6,259	0	0	20,372	0	0	4,117	
2	95008772	DOT Chiller Plant CP1	2,447	1,634	2,036	1,222	2,344	1,783	1,322	0	0	3,421	5,517	0	1,811	
3	2073865302	Federal Prison - High	1,941	1,322	1,439	1,020	1,794	1,531	1,020	1,156	1,156	1,732	1,532	1,659	1,442	
4	84602095	IICC	1,296	1,024	983	569	1,092	1,042	649	652	652	622	1,079	765	869	
5	9051819	Gate Gourmet	849	979	783	623	898	745	514	602	602	564	684	830	723	
6	2073891076	Federal Prison - Low	779	590	728	424	891	686	462	546	546	725	568	567	626	
7	1314727	Chelsea Catering	681	695	660	480	968	840	570	515	515	630	500	438	624	
8	10906484	FAA Tower	813	644	55	594	954	616	428	361	361	470	454	619	531	
9	78453321	So Ono	671	5,395	0	0	0	0	0	0	0	0	0	0	506	New Meter
10	70305475	Av Air Pro #3 - Car Wash	909	688	723	522	919	839	604	0	0	0	0	0	434	New Meter
11	60127955	DOT-A Gate 6 Triturator	506	402	412	275	574	602	410	242	242	497	586	0	396	
12	74470321	DOT – Low Dial – Baggage Claim	344	343	308	217	823	0	278	0	0	1,063	0	0	281	
13	85724744	DOT (Cent Conc Chiller)	664	0	344	239	789	0	272	0	0	407	610	0	277	
14	88868106	National Rent-A-Car	0	1	0	0	0	1	6	9	9	10	102	3,084	269	
15	14470322	DOT – Low Dial - Baggage Claim	302	276	269	173	668	0	225	0	0	850	0	0	230	
16	7133030	DOT-A Terminal 3 Chiller Mauka	139	1,356	0	0	0	0	0	0	0	938	0	0	203	
17	79189403	DOT – High Dial - Baggage Claim	882	71	217	79	449	0	139	0	0	506	0	0	195	
18	8008424	Budget Rent-A-Car	0	1	4	1	114	97	66	169	169	97	496	733	162	
19	8982925	FAA Tracon	58	52	147	105	226	148	272	67	67	157	105	125	127	
20	10906473	Enterprise Rent-A-Car	138	157	100	105	137	144	88	130	130	141	96	94	122	
		Total – Sub-meters	**21,721**	**17,372**	**15,708**	**7,862**	**27,458**	**11,078**	**15,922**	**5,740**	**5,740**	**35,613**	**15,134**	**10,504**	**15,821**	

Notes:

a. Includes both high and low readings with the same meter number.

FAA = Federal Aviation Administration

The following locations are targeted for alternative water source analysis because they are either currently one of the largest water users in HNL, posing significant potential for alternative water source utilization, or traditionally known as large water users, such as car and plane wash facilities. The new Consolidated Rental Car Facility (CONRAC) is expected to open in late 2020, and is added to the list to better understand their water usage because car wash facilities typically consume large volumes of water.

The primary facilities investigated in the water reuse study include the following:

- DOT-A CC chill tower
- DOT chiller plant CP1
- Federal Detention Center
- IICC
- Gate Gourmet
- CONRAC
- Passenger Terminals

Locations of these primary facilities are presented in Figure 2-2.

Legend

- Large Potable Water User
- Potable Water Line

N

0 0.25 0.5 Miles

Figure 2-2
HNL Location of Facilities
Honolulu International Airport
Honolulu, HI

Imagery Source: ©2014 Google
Modifications have been made

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2.1.1 DOT-A CC Chill Tower and DOT Chiller Plant CP1

The 3-million square foot airport facility is air-conditioned by three separate chilled water systems that serve the Diamond Head, Central, and Ewa (West) concourses. The Central Concourse chiller plant was replaced and upgraded in 2009, followed by the Ewa Concourse chiller plant in 2010. The three plants are connected by a 20-inch chilled water supply and return loop to provide flexibility and redundancy in operation since each of the chiller plants can generate and distribute cooling through the loop to other areas in the airport. This proves beneficial in the event that one of the plants is down for maintenance or repair, or at times when the airport conserves energy during periods of minimum loads.

The two major potable water users identified are DOT-A CC Chill Tower and DOT Chiller Plant CP1. Based on average billing data presented in Table 2-4, potable water consumption at these two locations are 0.13 and 0.06 MGD, respectively. This is approximately 37 percent of the total water volume of the top 20 meters based on recent billing records.

The DOT-A has taken proactive measures to develop sustainable practices that are in line with the State and the aviation industry, including evaluation of reclaimed water for cooling tower make-up.

2.1.2 Federal Detention Center

The FDC Honolulu is a United States federal prison facility in Hawaii that holds male and female prisoners of all security levels before or during court proceedings in the Hawaii Federal District Court, as well as inmates serving brief sentences. It is operated by the Federal Bureau of Prisons, a division of the United States Department of Justice.

FDC Honolulu is located adjacent to HNL, and is at the airport's western perimeter. The building has twelve stories. The average daily population fluctuates greatly.

Based on average billing data presented in Table 2-4, potable water consumption at the FDC is 0.07 MGD. This is approximately 13 percent of the total water volume of the top 20 meters based on recent billing records. As there is not a clear large, independent demand for non-potable water at the FDC, alternative water supply source opportunities are not evaluated further at this location.

2.1.3 International In-flight Catering Company and Gate Gourmet

Both IICC and Gate Gourmet are food catering companies. IICC provides inflight food catering to airlines, while Gate Gourmet provides catering and provisioning solutions for airport lounges, convenience stores, and related establishments. Based on average billing data presented in Table 2-4, potable water consumptions at these facilities are 0.03 and 0.02 MGD, respectively. This is approximately 10 percent of the total water volume of the top 20 meters based on recent billing records.

At these two facilities, most of the water is used in the food preparation, dish cleaning, and cart cleaning processes. The wastewater discharged would likely be high in Biochemical Oxygen Demand (BOD).

Because of the nature of the food service business, which is strictly regulated by multiple government agencies, including Food Safety and Inspection Service, U.S. Food and Drug Administration, Centers for Disease Control and Prevention, and the FAA, alternative water supply source opportunities are not evaluated further at these two locations.

2.1.4 Consolidated Rental Car Facility and AV Air Pro Car Wash #3

The new CONRAC will consolidate all rental car companies servicing HNL, including all on-Airport and off-Airport companies. It will be located east of the existing Overseas Terminal parking garage. The CONRAC will consist of five stories, which includes ready return areas, quick turnaround areas, and customer service areas. The CONRAC will include a total of approximately 2,250 parking stalls compared to an existing total of 895 parking stalls. A common busing operation (consolidating all rental car busing operations) will accommodate passengers to and from the various areas of the airport, to and from the CONRAC. It is expected to open in late 2020.

CONRAC is grouped with AV Air Pro Car Wash #3 for this study as the primary water usage at both sites will be the same, (vehicle washing), and therefore both facilities will require a similar water quality. Any new sources of supply treated to standards required for CONRAC can be supplied to AV Air Pro Car Wash #3 as well.

2.1.5 Passenger Terminals

The costs associated with retrofitting existing airport terminals with water reuse facilities (dual plumbing for toilet/urinal flushing) is prohibitively high because a separate reuse water supply network, or internal reuse plumbing network would need to be constructed within the existing restroom terminals. This requires major demolition and reconstruction. Therefore, new water supply source opportunities are not targeted at the existing airport terminals in this study. However, new source supply at any future terminals should be evaluated because a reuse water supply system could be designed and constructed as part of the new construction effort, if determined to be economically beneficial to HNL.

2.2 Inventory of Wastewater Generation

All wastewater generated at HNL discharges to the City and County of Honolulu's (CCH) 36-inch diameter sewer line located within Aolele Street and is ultimately processed at the Sand Island WWTP. HNL has eight connections to the CCH wastewater collection system. Most of the HNL wastewater system consists of gravity pipes. HNL also has three wastewater pump stations (WWPSs) and force mains (FMs). The wastewater system also uses sump pumps at various locations beneath the concourses to lift the wastewater to the gravity sewer lines. A map of the wastewater collection system is presented in Figure 2-3. Pump data at each pump station is listed in Table 2-5.

Legend

- Wastewater Pump Station
- Force Main
- Sewer Line

N

0 0.25 0.5 Miles

Figure 2-3
HNL Wastewater System
Honolulu International Airport
Honolulu, HI

Imagery Source: ©2014 Google
Modifications have been made

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Table 2-5. Pump Data at Wastewater Pump Stations at HNL

	Kalewa WWPS		Lagoon Drive WWPS			Elliott Street WWPS	
	Pump 1	**Pump 2**	**Pump 1**	**Pump 2**	**Pump 3 (Standby)**	**Pump 1**	**Pump 2**
Pump Manufacturer and Model Number	Gorman Rupp T4A-B-4	Gorman Rupp T4A-B-4	PACO 60122	PACO 60122	Allis-Chalmers Centrifugal Model 250 F7M2	ITT A-C Pump 300	ITT A-C Pump 300
Other Manufacturer Identifier	-	-	-	-	NSWV	NSWV	NSWV
Serial Number	-	-	-	-	751-19022-1-2	1/74700-01-1	1/74700-01-1
Pump Type	Self-Priming Centrifugal	Self-Priming Centrifugal	Vertical non-clog line shaft	Vertical non-clog line shaft	Vertical non-clog line shaft	Non-clog, solids handling, vertical	Non-clog, solids handling, vertical
Pump Size	-	-	-	-	6-inch x 6-inch x 12-inch	5-inch x 5-inch x 12-inch	5-inch x 5-inch x 12-inch
Total Dynamic Head	27.2 ft	27.2 ft	30 ft	30 ft	30 ft	116 ft	116 ft
Year Installed	2008	2008	1992	1992	Mid 1970s	1994	1994
Flow	250 gpm	250 gpm	1,000 gpm	1,000 gpm	1,000 gpm	1,150 gpm	1,150 gpm
Impeller Diameter	-	-	-	-	10.5 inches	11.62 inches	11.62 inches
Motor	5 HP	5 HP	15 HP, 240 V, 3 phase	15 HP, 240 V, 3 phase	15 HP, 240 V, 3 phase	50 HP, 460 V, 3 phase	50 HP, 460 V, 3 phase

Notes:

ft = feet
gpm = gallon per minute
HP = horsepower
V = volt

Because there is no direct metering of the wastewater discharge volume and flow at each consumer level, typically wastewater billing data is calculated based on potable water consumption. Because of much higher unit cost, the average wastewater cost for from 2009 through 2014, is approximately $5.0 M per year, as compared to $1.7 M per year for potable water charges presented in Table 2-6.

Table 2-6. Summary of Water and Wastewater Costs at HNL, 2009 to 2014

Year	2010	2011	2012	2013	2014
Water	$1,485,135	$1,469,340	$1,833,787	$1,802,997	$1,856,662
Sewer	$4,449,072	$4,728,997	$5,444,343	$5,104,799	$5,351,643
Total	**$5,934,207**	**$6,198,338**	**$7,278,130**	**$6,907,796**	**$7,208,305**

A *Wastewater System Study* was conducted by Belt Collins Hawaii LLC in 2014. The study reviewed the existing wastewater system and identified any existing or future deficiencies within the system. In the study, the HNL wastewater system is divided into eight separate zones. The study concluded no major deficiencies have been identified and all zones currently have capacity or the planned future improvements will have the capacity to handle the wastewater generated within the HNL service area. The Lagoon Drive WWPS, the Elliott Street WWPS, the Kalewa WWPS, and the Central Concourse Sump Pumps all have the capacity to support currently-planned projects. The wastewater flow at each WWPS is presented in Table 2-7.

Table 2-7. Wastewater Flow Estimates at Wastewater Pump Station at HNL, in MGD

Conditions	Flow MGD	Conditions	Flow MGD
Lagoon Drive WWPS (Zone B)			
Existing Average Flow	0.257	Future Average Flow	0.296
Existing Maximum Flow	1.018	Future Maximum Flow	1.139
Existing Design Maximum Flow	1.13	Future Design Maximum Flow	1.268
Existing Design Peak Flow	1.351	Future Design Peak Flow	1.523
Elliott Street WWPS (Zone H2)			
Existing Average Flow	0.269	Future Average Flow	0.279
Existing Maximum Flow	1.007	Future Maximum Flow	1.036
Existing Design Maximum Flow	1.022	Future Design Maximum Flow	1.053
Existing Design Peak Flow	1.191	Future Design Peak Flow	1.235
Kalewa WWPS (Zone A)			
Existing Average Flow	0.096	Future Average Flow	0.125
Existing Maximum Flow	0.375	Future Maximum Flow	0.46
Existing Peak Flow	0.433	Future Peak Future Flow	0.534

Source: *Wastewater System Study* (Belt Collins Hawaii LLC, 2014)

2.3 Potential Projects to Use Alternative Water Sources at HNL

The following is a listing of potential sources of Alternative Water and potential users of that water.

Table 2-8. Summary of Proposed Water Supply Alternatives at HNL

Potential Water Sources	Potential End Users
Onsite Scalping Plant	Cooling Tower
	CONRAC/Car-Wash
	Irrigation
	Washdown
Sumida Farms	Cooling Tower
	CONRAC/Car-Wash
	Irrigation
	Washdown
Storm water Harvesting	Cooling Tower
	CONRAC/Car-Wash
	Irrigation
	Washdown
Rainwater Harvesting	Irrigation
	Washdown
Desalination	Full Potable Demand

2.4 Potential Alternative Water Sources and Users of Non-Potable Water Sources

HNL receives non-potable water from Sumida Watercress Farms, via a DOT-H line along Nimitz Highway. The source of the non-potable water is a 1 MG reservoir fed by a combination of runoff from the farm, and Kalauao Springs. DOT-A paid for the installation of the non-potable supply line, and under an agreement with DOT-H does not pay for any of the non-potable water supplied from this source. This non-potable water supplies the majority of the irrigation demand at HNL, however there are still a few irrigation lines that are connected to the potable water supply system. USGS Data from 2000-2012 shows an average discharge of 8.7 MGD from the Kalauao Springs, suggesting a potential supply much greater than the current non-potable demand. Average conductivity over the same time period is approximately 1700 micro-Siemens/centimeter. With a TDS:conductivity ratio of 0.65, this conductivity would translate to approximately 1,100 mg/L TDS, which would qualify as brackish.

2.4.1 Potential Alternative Water Sources

2.4.1.1 Storm Water

A Small Municipal Separate Storm Sewer System drains storm water from structures, runways, taxiways, and roadways at HNL into Keʻehi Lagoon, Mamala Bay, and Manuwai Canal. The DOT-A Environmental Section manages the HNL storm sewer system and ensures compliance via storm water monitoring.

The storm water system is a complex network of drainage canals with multiple outfalls into receiving waters. Detailed rainfall runoff modelling would provide an accurate depiction of the true volume and frequency of storm water available for reuse, and optimal locations for conveyance and storage facilities. However, two potential locations for storm water capture and storage are shown in Figures 2-4 and 2-5. These locations are upstream of two large outfalls, and should provide a significant portion of potential supply. These locations are also used as sample points for historical monitoring, so reliable data would exist to support appropriate treatment and conveyance design. Flow rates and water quality vary greatly depending upon the season and daily precipitation. However, permitted limits for the two recommended intake locations are provided in the HNL Storm Water Management Program Plan, Section E, Tables 1-4. Permit activities to monitor storm water quality and storm water infrastructure include total suspended solids (TSS) and herbicide application monitoring, and debris removal and structural maintenance monitoring, respectively.

The intake structures should be located far enough upstream to avoid potential salt water intrusion from the Keehi lagoon, and Manuwai canal, respectively. Treatment would generally occur immediately after intake, depending on the initial storm water quality, and the final desired quality of the product. After treatment the water should be stored in underground cisterns or covered above-ground tanks. Storm water could also be blended with other sources of non-potable water (Sumida Farm or rainwater), to dilute high concentrations of certain contaminants within acceptable ranges, and provide a uniform non-potable water distribution system.

2.4.1.2 Rainwater Harvesting

Rainwater harvesting during high precipitation months may provide a viable source of water for R-1 water activities. The highest precipitation months are from October through April, and low precipitation months are from May through September. From 2000-2016, average annual rainfall was approximately 20.6 inches. The rainwater collected depends on the surface area used for the rainwater harvesting system and roofing material of the airport buildings. Assuming an average of 16.2 inches per year falling on impervious roofing material, approximately 9,000 gallons of water can be collected per 1,000 square feet of roofing. Possible rainwater harvesting locations are shown in Figure 2-6.

Legend

- Stormwater Intake Potential Location
- Force Main
- Non-Potable Water
- Potable Water
- Sewer Line
- Stormwater Channel
- Potential Storage Tank

N

0 400 800 Feet

Figure 2-4
East Potential Storm Water Intake and Storage
Honolulu International Airport
Honolulu, HI

ch2m:

Imagery Source: Esri, 2016

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Legend

- Stormwater Intake Potential Location
- Force Main
- Non-Potable Water
- Potable Water
- Sewer Line
- Stormwater Channel
- Potential Storage Tank

N

0 250 500 Feet

Imagery Source: ©2014 Google
Modifications have been made

Figure 2-5
West Potential Storm Water Intake and Storage
Honolulu International Airport
Honolulu, HI

ch2m

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Legend

Potential Rainwater Harvesting Location

N

0 550 1,100 Feet

Figure 2-6
Potential Rainwater Harvesting Locations
Honolulu International Airport
Honolulu, HI

ch2m.

Imagery Source: ©2014 Google
Modifications have been made

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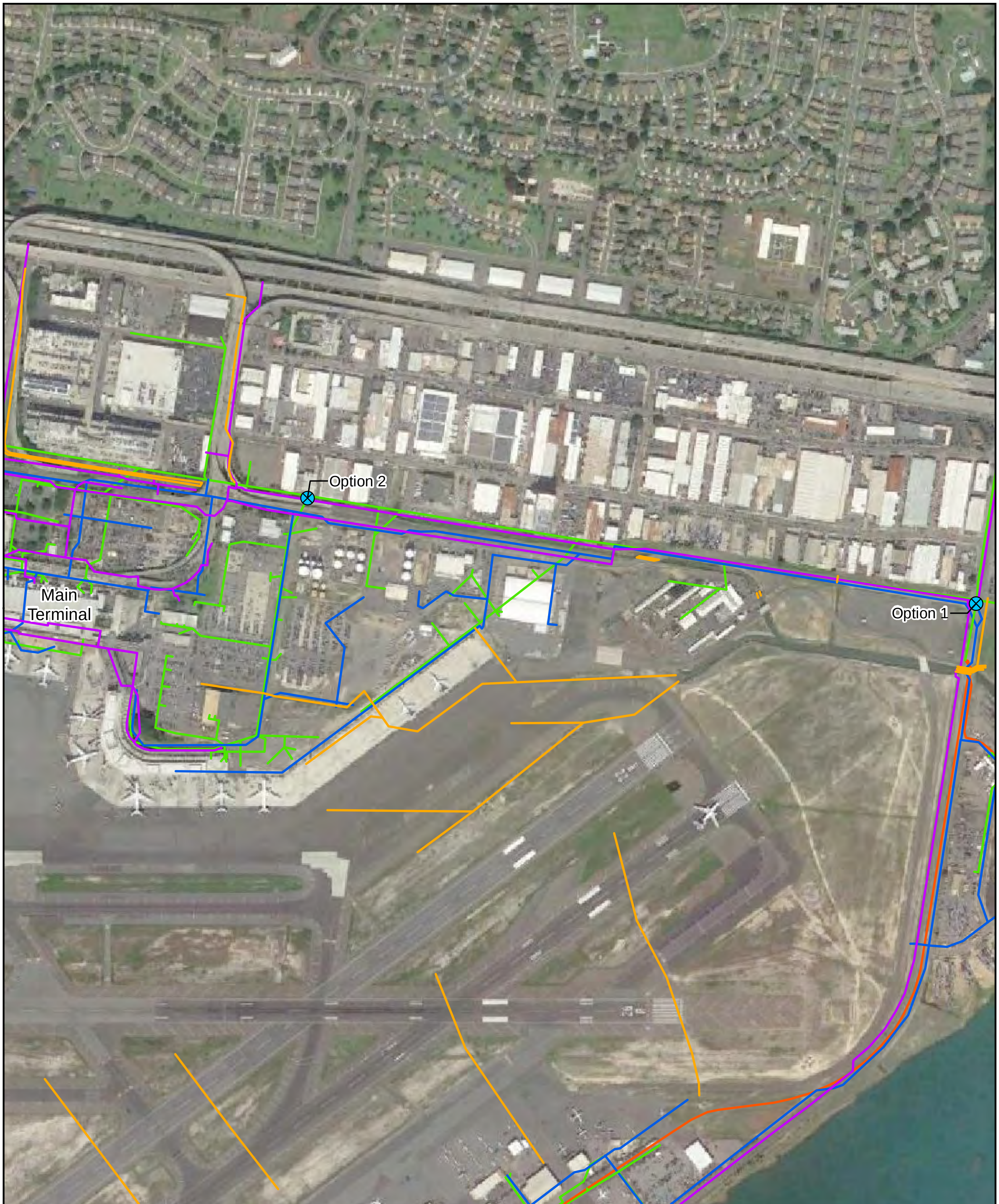
2.4.1.3 Blowdown

Blowdown water is generated from the air conditioning system at HNL. Water used in the air conditioner chillers is periodically discharged to purge accumulated minerals that could cause corrosion or scaling. This water may also contain algae, bacteria, pathogens and residual chemical additives. Currently, blowdown water is discharged to the sanitary sewer system for treatment. Blowdown water flow rate and quality can vary greatly, and approximate values are unknown at this time because these parameters are not currently documented by DOT-A. Reclaimed blowdown water can be used for make-up water in the air condition system, however, this may increase mineral concentrations over the long term. The blowdown water would also provide a low quantity relative to the required air conditioning system make-up water demand. Because of these limitations, independent treatment of blowdown water for reuse is not recommended at HNL. Instead the blowdown water would continue to be discharged to the sanitary sewer system, where it could form part of the wastewater supply available for scalping and reuse.

2.4.1.4 Onsite Wastewater Treatment

Currently at HNL, the wastewater discharge is not metered. Instead, it is estimated by CCH for billing purposes. However, as very little potable water is used onsite for irrigation, it is reasonable to assume that the wastewater volume is similar to that of the potable water supply. Instead of allowing the wastewater to flow to the Sand Island WWTP, the water could be scalped and treated onsite. The potential locations for a scalping facility are presented in Figure 2-7. Option 1 location is sited to collect the maximum amount of wastewater flow. Option 2 location will not collect maximum flow, but will be located closer to the primary end users of the recycled water (all located in the main terminal), thereby minimizing conveyance costs.



Legend

Scalping Plant Potential Location
Force Main
Non-Potable Water
Potable Water
Sewer Line
Stormwater Channel

N

0 400 800
Feet

Figure 2-7
Potential Wastewater
Scalping Plant Locations
Honolulu International Airport
Honolulu, HI

ch2m:

Imagery Source: ©2014 Google
Modifications have been made

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2.4.1.5 Offsite Wastewater Treatment

Another potential source for recycled water is wastewater generated at a local WWTP, and then conveyed to HNL. However, the two best sources for this water are not feasible at this time. The Honouliuli WWTP currently has a water reuse program, and it is not feasible to add an additional large Facility, such as HNL, given their current recycled water production. Sand Island currently does not have a secondary treatment system; the wastewater undergoes primary treatment and disinfection before ocean discharge. This means that their effluent is not treated to an R-3 level. Treatment to R-3 would require conveyance of Sand Island effluent to HNL, where a package plant (using an MBR, or other process) would provide secondary treatment in addition to potentially other steps to produce R-2 or R-1 water as required. If domestic wastewater is to be a source of recycled water for HNL, onsite scalping and treatment is a much more feasible option when compared with offsite treatment provided that solids from the scalping plant can be discharged to the sewer downstream of the scalping plant abstraction point. Therefore, this option is not considered as a potential source.

2.4.1.6 Washdown Water

Washdown water is used by airlines, DOT-A personnel, and others to clean maintenance equipment and vehicles. The water would typically contain oils, greases, volatile organic contaminants, and potential pathogens. Washdown water flow rates are minimal, and are disposed of in two drying beds; one large primary drying bed that services most washdown areas, and one small drying bed at the south end of the airport, serving a small plane washdown area. Due to the minimal and irregular washdown flow rate, washdown water is not considered a potential source.

2.4.1.7 Desalination

From the 1990 County of Oahu Water Use Plan, the groundwater around HNL contains a caprock barrier, restricting seaward flow of fresh water, and causing a larger freshwater lens than if the caprock was absent. Detailed sampling is required to determine the current quality of aquifers surrounding HNL, however with fresh water supply available via groundwater, seawater appears to be the best option available if desalination is desired as an alternative source. This would be accomplished via a beach well versus an open ocean intake. Seawater desalination via an open intake structure is a viable non-potable source for HNL, however it will likely be the most expensive supply alternative.

2.4.2 Potential Users of Alternative Water Sources

2.4.2.1 Cooling Towers

HNL uses four chillers with cooling towers for air conditioning of its facilities. These chillers account for over 40 percent of the potable water demand at HNL, with two (DOT-A CC Chill Tower and DOT Chiller Plant CP1) accounting for over 37 percent of the top 20 water accounts.

Water quality can significantly impact the water use efficiency and operations of a cooling tower. All cooling towers require some level of water treatment, no matter the water source. The main issues associated with contaminants in water for cooling towers is corrosion, scaling and biofouling. Corrosion is an electrochemical process by which a metal returns to its natural oxide state. Carbon steel is a commonly used metal in cooling water systems and is susceptible to corrosion where chloride and total dissolved solids are elevated. Corrosion can be in the tower itself, the condenser bundle of the chiller, the piping/pumping system, or all three locations. Corrosion leads to failure of equipment as metal weakens and eventually disintegrates. Performance loss is because of fouling, scale, or microbiological slimes/films coating heat transfer surfaces of the cooling system. This results in less efficient heat transfer and can cause a complete loss of cooling capacity.

Make-up water for cooling towers is a compromise of water usage and “Cycles of Concentration” (COC). COC is how often water is allowed to flow through a system before it is removed (“blowdown”).

A COC of 1 would mean that the water would be a single pass through the tower/chiller. A COC of 10 would mean that it would cycle 10 times before it is discharged through blowdown.

A cooling tower works through an evaporation process. Some water evaporates as it runs through the cooling tower. This is generally about 1.8 gallons per hour (gal/hr) per ton of cooling. A cooling tower providing 5,000 tons of cooling and operating continuously over a 24-hour period would evaporate 5,000 tons * 1.8 gal/hr per ton * 24 hours = 216,000 gallons per day. As the water evaporates, the minerals, sediment, and biologicals remain in the water and increase in concentration. For example, if the TDS of the make-up water is 56 mg/L level, the TDS would increase to 112 mg/L at a COC of 2, 224 mg/L at a COC of 4. Conversely, as COC increases, the amount of make-up water required is reduced proportionately. Increasing COC from 2 to 6 would result in a 1.44 gal/hr per ton reduction, whereas increasing COC from 6 to 10 would result in only a 0.16 gal/hr per ton reduction. Increasing beyond a COC of 6 has a diminishing return on water savings, but will significantly increase the concentration of BOD, TSS, TDS and other constituents that will increase the degree of fouling, scaling, biofilm formation, corrosion, and performance loss. All cooling towers use some level of chemical treatment for corrosion and scale control, as well as biofilm and algae management. Some use physical treatment (such as electromagnetic systems) as well, to reduce chemical requirements.

Depending on the quality of any new cooling tower water supply, the COC and chemical treatment currently employed at the cooling towers may be impacted. Therefore, thorough testing of any new sources is required prior to replacement of the existing cooling tower potable supply. Despite required testing and potential changes to COC and treatment practices, using a non-potable or reuse water source is very feasible. The operators will need to make sure they stay focused on the revised water quality levels and adjust their chemical treatment operations accordingly.

2.4.2.2 Consolidated Rental Car Facility and AV Air-Pro #3 Car Wash

The CONRAC slated to open in 2020 will require significant water supply for vehicle washing (see Section 2.1.4 for additional information on the CONRAC facility at HNL). Current meters associated with car washes and rental car facilities indicate water consumption of approximately 1 million gallons per month. Therefore, the CONRAC facility, coupled with the existing AV Air-Pro #3 Car Wash Facility could account for over 6 percent of the total potable demand.

R-1 water would be suitable for use in this facility, in addition to the non-potable supply from Sumida Farms or treated storm water. An additional option is to employ an onsite water treatment system at the car wash facility to produce water for reuse onsite. Given that the CONRAC facility planning and construction is currently or will soon be underway, conveyance of recycled water to the facility would need to be determined. Recycled water access at the facility would highly depend on the source of the reuse water and the water’s treatment location. One potential challenge is the spotting that can occur on vehicles washed with hard or high TDS water. Further sampling of potential reuse sources is required to determine if the quality of each supply, however there are de-ionization methods available to remove minerals from the carl wash water.

The use of R-1 water at the CONRAC facility would likely require that there are no self-service stations, or that self-service stations use potable water instead of recycled water. For example, California regulations require the use of tertiary treated (R-1) water for car washes, and prohibit car owners to wash their own vehicles.

2.4.2.3 Irrigation

Sumida Farm provides the majority of the irrigation water used at HNL. However, there are still some legacy irrigation lines that continue to be supplied with potable water. While the exact location and demands associated with these legacy lines are currently unknown, they represent ideal candidates for supply by non-potable or recycled water. Further investigation is needed to determine the feasibility of such a conversion.

2.4.2.4 Washdown

Water used for airport vehicle washdown would have similar requirements to that of the water used for CONRAC. While the CONRAC demand will be centralized, the washdown water demands will be distributed across six different locations. Due to the potential treatment required, as well as the relatively low demands, washdown water does not merit service from a wastewater or storm water reuse system. However, there are several locations where washdown water could connect with the existing non-potable supply system, or a rainwater harvesting system.

2.5 Narrative Description of Alternatives

The following narratives provide an overview of the opportunities for HNL to use reclaimed water for non-potable uses including irrigation, cooling tower operation, and vehicle washing. Each of these uses requires further investigation and optimization to confirm feasibility and estimate the reduction in potable water use. A summary of the options are listed in Table 2-9.

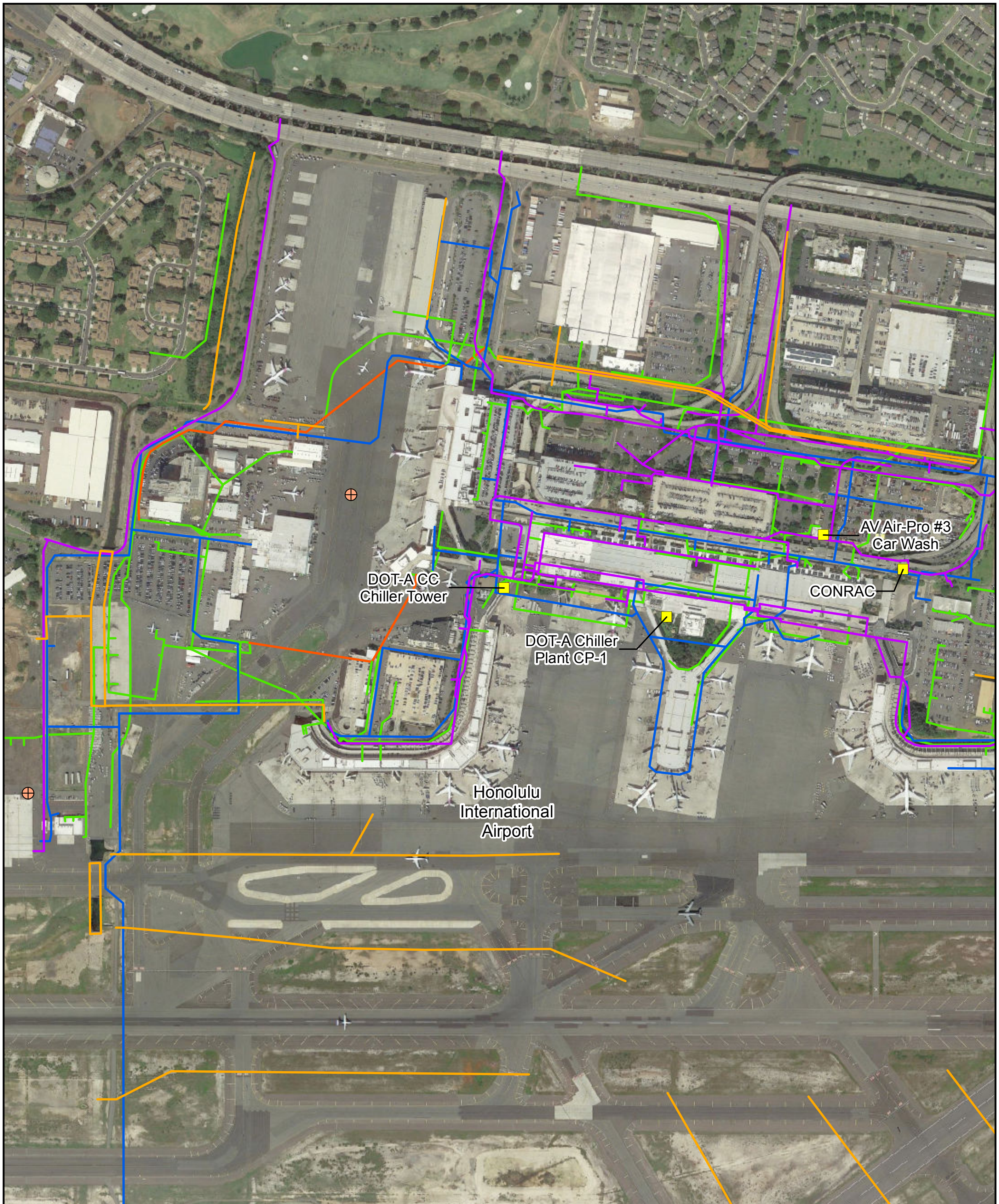
Table 2-9. Summary of Potential Alternative Water Sources and Facilities

Potential Water Sources	Potential Facilities
Onsite Scalping Plant	Cooling Tower
	CONRAC/Car-Wash
	Irrigation
	Washdown
Sumida Farms	Cooling Tower
	CONRAC/Car-Wash
	Irrigation
	Washdown
Storm Water Harvesting	Cooling Tower
	CONRAC/Car-Wash
	Irrigation
	Washdown
Rainwater Harvesting	Irrigation
	Washdown
Desalination	Full Potable Demand

2.5.1 Alternative 1: Expansion of Sumida Farms Non-potable Supply

Because of its existing storage and conveyance infrastructure, the first option should be to use the full supply of non-potable water from Sumida Farm. The initial task is to identify the existing irrigation lines that still use potable water, and assess the feasibility to convert to the non-potable supply. Initial water quality data shows slightly brackish water, which may require treatment, or blending with potable water, before use in vehicle washing or cooling tower make-up water. Further testing will determine required treatment for additional uses, and help to provide the cost-benefit of using the non-potable supply for cooling tower, CONRAC, or washdown water. De-ionization may be required to remove minerals, and chemical treatment may need to be adjusted to prevent biological growth or corrosion.

While much of the potential required non-potable piping exists, larger pipes may need to be installed to accommodate higher flow rates for the cooling towers and CONRAC. Figure 2-8 shows the new potential users and system connects with an expanded non-potable supply from Sumida Farm, (additional potential washdown areas not shown for clarity).



Legend

- Potential User
- Washdown
- Force Main
- Non-Potable Water
- Potable Water
- Sewer Line
- Stormwater Channel

N

0 375 750 Feet

Imagery Source: ©2014 Google
Modifications have been made

Figure 2-8
Potential Users for Expanded Non - Potable Supply System at HNL
Honolulu International Airport
Honolulu, HI

ch2m

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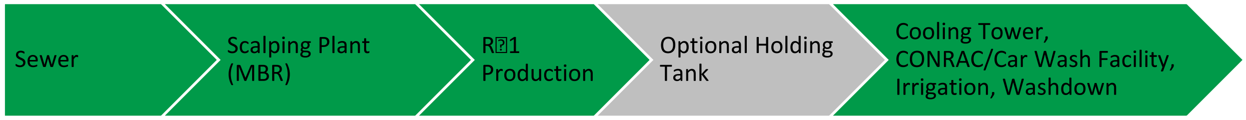
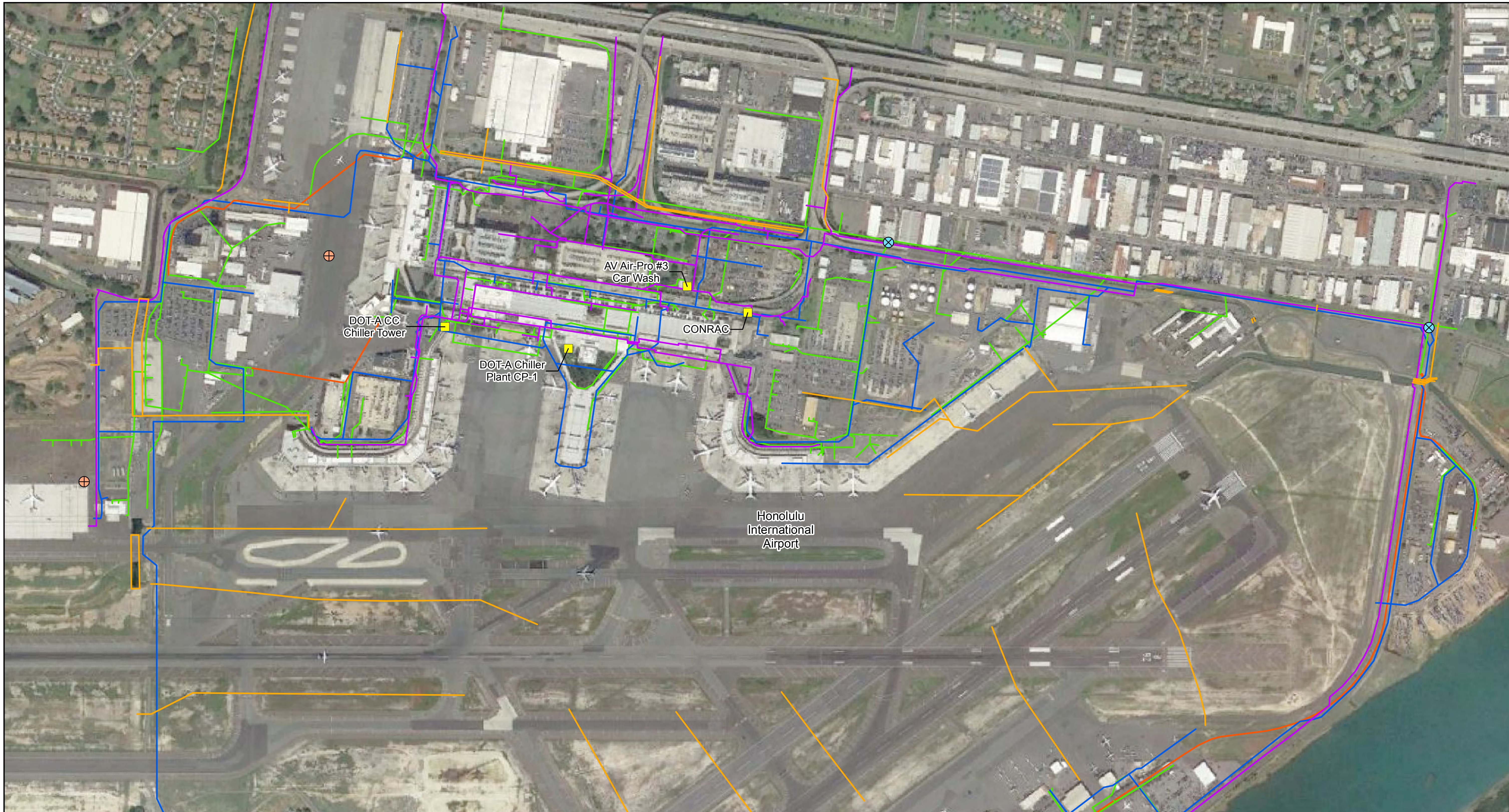
2.5.2 Alternative 2: R-1 Water from On-site Scalping Plant



The scalping plant would produce R-1 water for use in the cooling tower and vehicle washing. New lines from the scalping plant would be required to these larger users. This water would also be suitable for any further irrigation or washdown water requirements, however, to supply irrigation and washdown, the scalping plant would need to connect to the existing non-potable supply network. If this connection was not cost efficient, then this option should proceed with only the cooling tower and vehicle wash demands.

The maximum demand from all facilities (excluding the unknown irrigation demand) would be approximately 0.23 MGD, or 44 percent of the potable demand. Although wastewater flow from HNL is not metered, from Table 2-7 the pumped system only, (which represents only a portion of the overall wastewater flow), has an average capacity of 0.62 MGD. This suggests that the available water for scalping would be sufficient to meet maximum non-potable demands, although a treated R-1 storage system may be required depending on diurnal wastewater flow variation and demand schedule. An additional benefit of this option is that the supply will be consistent regardless of precipitation, unlike the supplies from storm water, rainwater harvesting, or even Sumida Farm (which is spring-fed). Figure 2-9 shows potential scalping plant locations.



Legend

- Scalping Plant Potential Location
- Washdown
- Potential User
- Force Main
- Non-Potable Water
- Potable Water
- Sewer Line
- Stormwater Channel

N

0 500 1,000 Feet

Imagery Source: Esri, 2016

Figure 2-9
Potential Locations for Onsite Scalping Plant
Honolulu International Airport
Honolulu, HI

ch2m:

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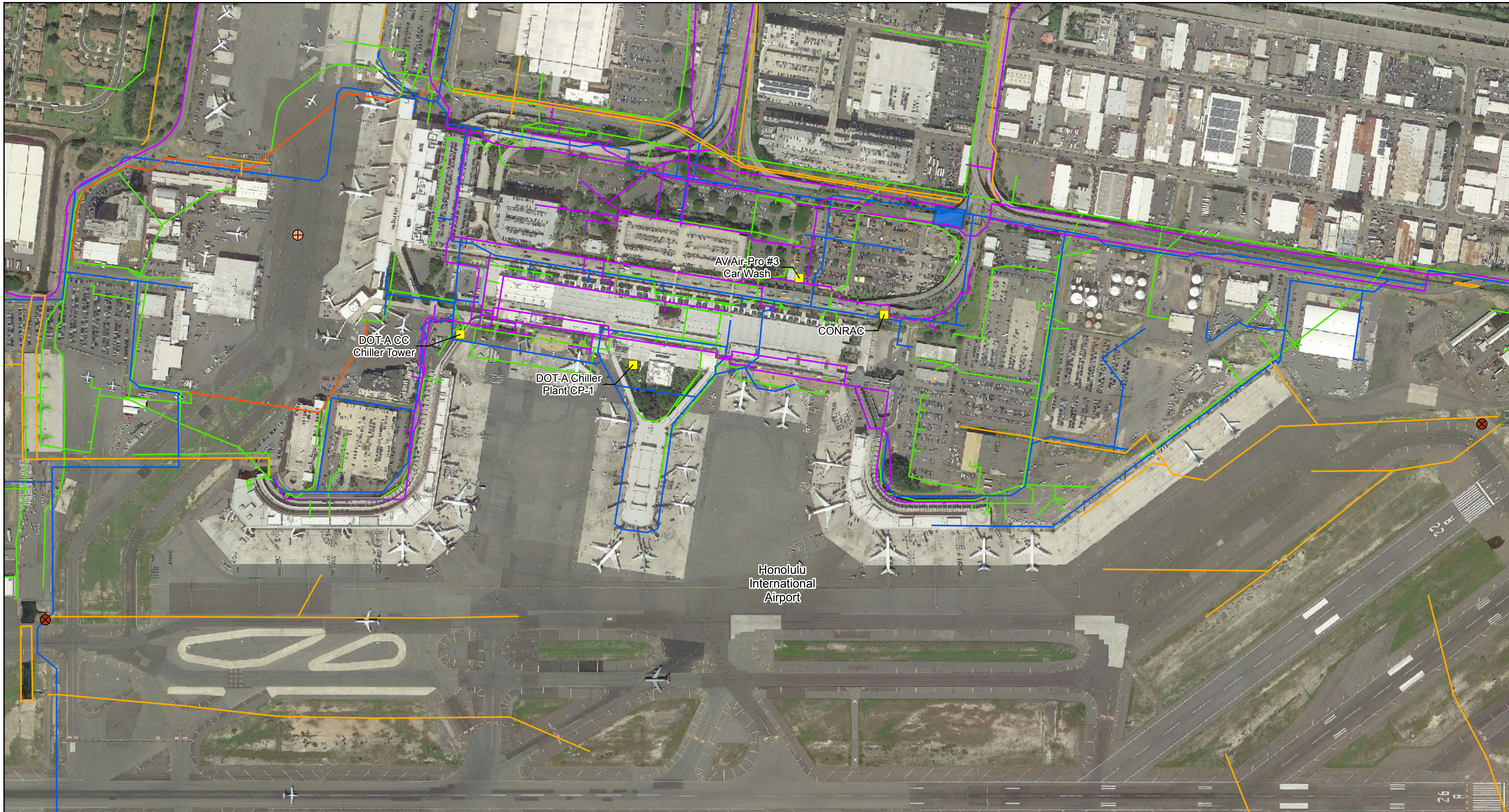
2.5.3 Alternative 3: Storm Water and Non-Potable Sumida Farm Water

In this alternative, the available (non-committed) water used from Sumida should be maximized to supply all non-potable demands. Any deficiencies between the supply and demand will be met by storm water capture and potential treatment. The number and location of the storm water capture stations will depend upon the volume remaining after Sumida Farm water. From the HNL Storm Water Program Management Plan, one potential capture station that feeds to Keehi Lagoon with primarily maintenance yard runoff, has a discharge capacity of approximately 0.54 MGD (the total capture volume would depend on the storm duration). This flow must be stored for use during system demands, as these demands will not typically correlate with precipitation. Storm water capture will most likely require new lines to the major users (cooling towers, vehicle washing), although it may be possible to use existing non potable lines for conveyance if the blending of the two sources produces appropriate water quality, and the lines have sufficient capacity. Similar to previous alternatives, washdown water should only be considered for service from the storm water system if it can easily be connected to the existing non-potable supply system. If not, they storm water should only supply the larger users. Figure 2-10 shows a potential storm water capture, storage, and distribution system.



Legend

- Stormwater Intake Potential Location
- Washdown
- Potential User
- Potential Storage Tank
- Force Main
- Non-Potable Water
- Potable Water
- Sewer Line
- Stormwater Channel

N

0 250 500 Feet

Imagery Source: Esri, 2016

Figure 2-10
Potential Locations for Storm Water Capture Systems
Honolulu International Airport
Honolulu, HI

ch2m.

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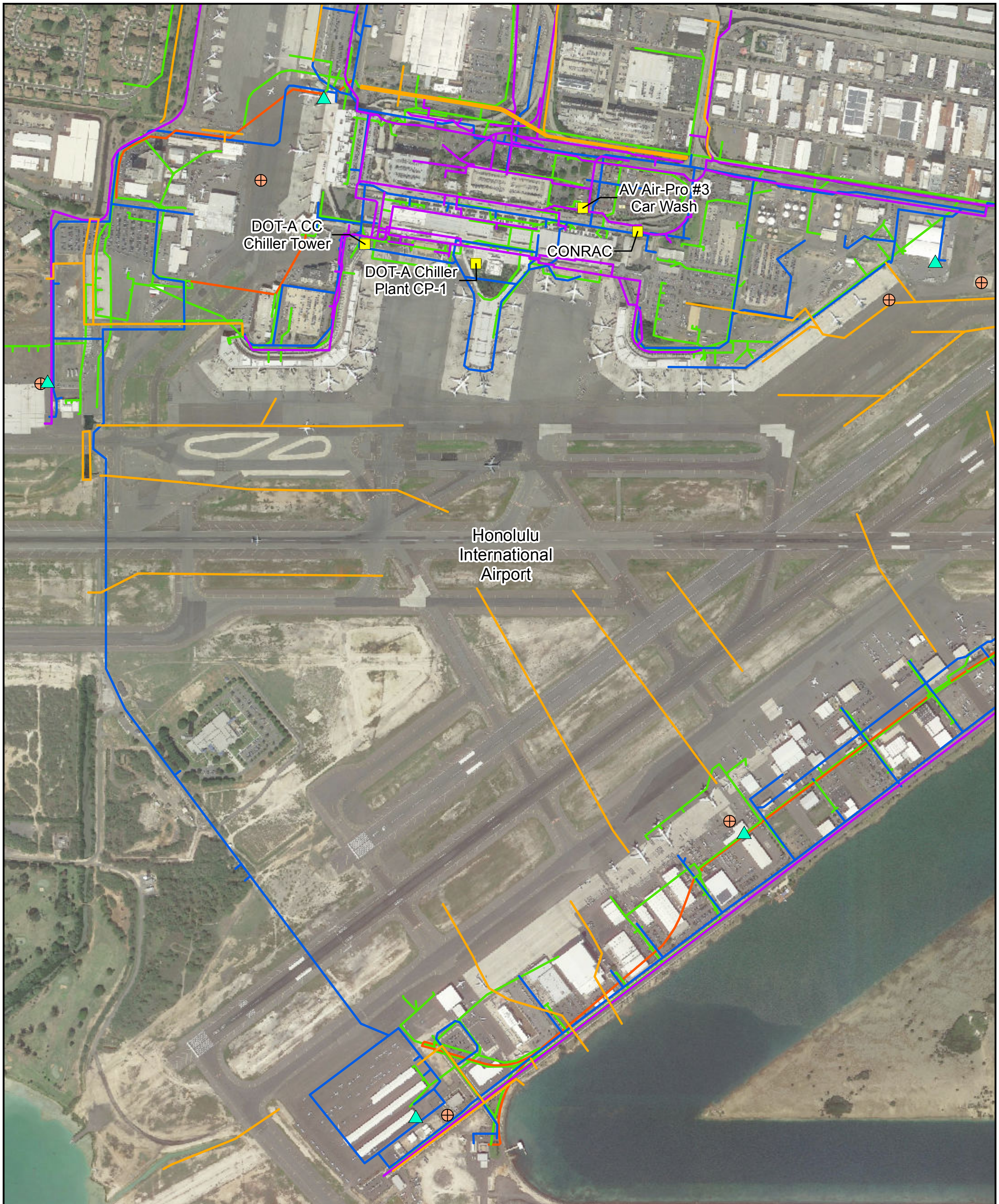
2.5.4 Alternative 4: Rainwater Harvesting and Non-Potable Sumida Farm Water

Rainwater → Local Storage Tanks → Washdown or Non-Potable System

Rainwater will be harvested from structures that can provide significant supply to local washdown areas. The rainwater may have to undergo some filtration, and will require booster pumps to supply adequate pressure to the washdown hoses. The rainwater tanks could also be connected to the non-potable supply line where possible, if additional supply or system pressure were required. Similar to Alternative 3, the available water used from Sumida should be maximized to supply as many non-potable demands as possible. Figure 2-11 shows a potential rainwater harvesting system.



Legend

- Potential Rainwater Harvesting Location
- Potential User
- Washdown
- Force Main
- Non-Potable Water
- Potable Water
- Sewer Line
- Stormwater Channel

N

0 550 1,100 Feet

Imagery Source: ©2014 Google
Modifications have been made

Figure 2-11
Potential Rainwater Harvesting System for Washdown and Irrigation
Honolulu International Airport
Honolulu, HI

ch2m

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2.5.5 Alternative 5: Desalination Water

The most cost effective use of desalination will be to supply the full potable demand of HNL via beach wells. The maximum month potable demand at HNL is approximately 1,532 gpm, which is high compared with the demands at other airports, (although low when compared with larger municipal demands). The economy of scale associate with desalination would decrease the relative cost of the desalinated water at HNL as well, increasing the viability of desalination as an option.

Because of the apparent freshwater lens in the ground surrounding HNL, fresh groundwater should be available. However, while there may be a supply of freshwater, desalination of deeper brackish or saline water would most likely still be less expensive than an open ocean intake. Detailed sampling of depth and quality would reveal the optimal desalination intake configuration.

Water would undergo RO and disinfection treatment near the well structure, followed by conveyance to an optional storage tank, and connection with the existing potable system. Chemical addition (post treatment) will also be required to make the desalinated water compatible with distribution and end use infrastructure (non-corrosive). The facility will be sized to supply the maximum month water demand of 1,532 gpm. Further investigation is required to determine if there is access to seawater used for cooling at a power plant. If not, then a beach well and brine outfall will be required.

2.6 Regulatory and Contractual Assessment

Table 2-10. Summary of Potential Regulatory and Contractual Issues

Potential Water Sources	Potential Facilities	Regulatory/Contracting Issues
Onsite Scalping Plant	Cooling Tower CONRAC/Car-Wash Irrigation Washdown	HDOH Recycled Water Guidelines
Sumida Farms	Cooling Tower CONRAC/Car-Wash Irrigation Washdown	N/A
Storm water Harvesting	Cooling Tower CONRAC/Car-Wash Irrigation Washdown	N/A
Rainwater Harvesting	Irrigation Washdown	N/A
Desalination	Full Potable Demand	N/A

SECTION 3

Kahului Airport (OGG)

Kahului Airport (OGG) is the primary airport on the island of Maui and receives both overseas and interisland flights. It is located on the northern edge of the land bridge between Haleakala and the West Maui Mountain Range on the island of Maui. The airport occupies 1,391 acres of land and is located 3 miles east of the town of Kahului. Kahului is the second busiest airport in the State of Hawaii and the newest in terms of terminal facilities.

The airport has two intersecting runways and full air carrier facilities for domestic overseas and interisland commercial service. Kahului Airport provides commuter and air taxi and general aviation operations, including helicopter operations in separate locations. The airport has two terminals, a main terminal and a commuter terminal, and averages 7,000 passengers per day (enplanement).

The $2.3-billion Hawaii Airports Modernization Program initiated in March 2006 is now well under way, with important improvements already completed or under construction at all major airports in the system. At OGG, these projects include the construction of a new CONRAC.

3.1 Inventory of Water Use

OGG's water distribution system was supplied by the Department of Water Supply, County of Maui. Water consumers at OGG (totaling 41 meter accounts) are served by water lines, as presented in Figure 3-1.

HDOT provided historical water meter readings during the period from August 2015 to September 2016, for all 41 water meters at OGG. Cumulative meter readings were taken monthly at each meter location and water usage for the month was then calculated by subtracting the meter reading of the previous month from the current month.

A summary of potable water usage data is provided in Table 3-1. Table 3-1 ranked all the meter locations by the highest average potable water usage for the most recent 12 months (October 2015 to September 2016). Based on the historical water billing data for the last 12 months, the average water consumption across the OGG system was calculated to be 4.3 MG/month, or 0.14 MGD, as presented in Table 3-1, which includes water consumed for fire protection. The water cost for the month of September 2016 is approximately $24,000, when 4.1 MG (3.765 MG for domestic use plus 0.315 MG for fire protection) were consumed. This is prorated to a water cost of $26,000 per month for an average monthly consumption of 4.3 MG.

Legend

Potable Water Line

N

0 350 700
Feet

Figure 3-1
OGG Water System
Kahului Airport
Kahului, HI

Imagery Source: ©2014 Google
Modifications have been made

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Table 3-1. Summary of Water Usage at OGG, in 1,000 gallons

Rank	Account No.	Address	Customer	Meter No.	Type	Sept-16	Aug-16	Jul-16	Jun-16	May-16	Apr-16	Mar-16	Feb-16	Jan-16	Dec-15	Nov-15	Oct-15	12-Month Average
1	7623442014	Kahului Airport	TBD	96931096	Terminal and Heliport	1,034	1,324	1,172	1,003	1,174	1,093	1,159	1,138	1,383	1,294	1,521	1,554	1,237.4
2	4465796054	Kahului Airport	TBD	96931102	Terminal and Heliport	870	1,122	996	855	1,001	937	992	976	1,184	1,106	1,297	1,321	1,054.8
3	4868503476	Kahului Airport	TBD	96931071	Terminal and Heliport	793	1,027	909	777	911	850	903	887	1,077	1,004	1,180	1,206	960.3
4	6995999752	Airport East Ramp	TBD	96998069	Systems and Services	373	393	396	410	389	335	307	271	356	294	341	361	352.2
5	5175081828	Aalele Street	TBD	97594377	Terminal and Heliport	301	288	338	256	215	259	230	218	263	227	211	263	255.8
6	3884106640[a]	Keolani Place	TBD	97296647	Terminal and Heliport	104	121	80	107	103	366	186	62	84	80	337	220	154.2
7	7174112499[a]	Keolani Place	TBD	33732726	Systems and Services	102	108	99	132	105	135	126	118	94	151	100	39	109.1
8	4286557488	Keolani Place Commuter Terminal	TBD	15723084	Systems and Services	16	17	16	88	30	108	80	40	93	104	118	100	67.5
9	5463573802[b]	Eena Street/Airport aircraft rescue and firefighting	TBD	97948149	Airport aircraft rescue and firefighting	72	40	44	39	68	45	44	41	50	41	44	50	48.2
10	5199492231	700 Kaonawai Place	TBD	9100043	Systems and Services	51	86	46	26	26	26	25	22	27	22	25	2	32.0
11	2887147595[c]	Keolani Place	TBD	45353520	Systems and Services	287	2	6	2	3	6	3	48	1	2	1	2	30.3
12	3896339456[a]	Amala Place (very end)	TBD	96998385	Systems and Services	19	15	28	14	7	10	20	2	3	3	5	24	12.5
13	867269254	Kahului Airport	TBD	97148000	Terminal and Heliport	10	9	10	7	7	16	20	16	13	4	6	3	10.1
14	9834755657[a]	Amala Place (very end)	TBD	96998386	Systems and Services	12	6	21	6	-	5	17	-	-	-	-	21	7.3
15	8914081273	685 Kahale Street	TBD	96995948	Systems and Services	9	5	19	5	7	4	4	18	4	2	3	3	6.9
16	5657281406	Maintenance Building	TBD	32331010	Terminal and Heliport	3	3	3	3	3	4	3	2	13	4	5	5	4.3
17	8196669817[a]	Keolani Place/Lot Booth	TBD	97148045	Systems and Services	2	1	2	1	3	2	2	2	2	2	2	1	1.8
18	7086151007[a]	Paia Spur Road/Lot 8	TBD	40681982	Systems and Services	19	-	-	-	-	-	-	-	-	-	-	-	1.6
19	953595208*[a]	Poepoe Circle	TBD	97594379	Systems and Services	1	1	1	1	1	2	1	2	2	1	-	-	1.1
20	3807440427[a]	Paia Spur Road/Lot 5	TBD	40681984	Systems and Services	1	2	3	1	-	-	-	-	-	-	-	-	0.6
21	6235901860[a]	Kahului Airport Exit	TBD	35688626	Terminal and Heliport	1	1	-	1	-	-	-	1	-	-	1	-	0.4
					Total	**4,080**	**4,571**	**4,189**	**3,734**	**4,053**	**4,203**	**4,122**	**3,864**	**4,649**	**4,341**	**5,197**	**5,175**	**4,348**

Note:

a. Irrigation meters. These accounts are charged for water, but not wastewater.

b. 35 MG was consumed for fire protection in September 2016.

c. 280 MG was consumed for fire protection in September 2016.

The following locations are targeted for alternative water source analysis because they are either currently one of the largest water users in OGG and pose significant potential for alternative water usage, or traditionally known as large water users, such as car and plane wash facilities. The new CONRAC is expected to open in 2020, and is added to the list to better understand their water usage, as car wash facilities typically consume large volumes of water.

The primary facilities investigated in the water reuse study include the following:

- Cooling tower
- Terminals and heliports
- CONRAC
- Irrigation along Keolani Place

Locations of these primary facilities are presented in Figure 3-2.

Legend
- Kahului WRF
- Large User
- Potable Water Line

0 500 1,000
Feet

Figure 3-2
OGG Location of Facilities
Kahului Airport
Kahului, HI

Imagery Source: ©2014 Google
Modifications have been made

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3.1.1 Cooling Tower

The chiller plant serves the air conditioning system at OGG. The list of customers that correspond to the meter numbers has not been provided, therefore, a definitive value cannot be assigned to the water usage of the cooling tower. However, cooling towers in warm environments typically are a substantial user of potable water.

3.1.2 Passenger Terminals

The costs associated with retrofitting existing airport terminals with water reuse facilities is prohibitively high because a separate reuse water supply network, or internal reuse plumbing network, would need to be constructed within the existing restroom terminals. This requires major demolition and reconstruction. Therefore, alternative water supply sources are not targeted at the existing airport terminals in this study. However, water reuse at any future terminals should be evaluated because a reuse water supply system could be designed and constructed as part of the new construction effort, if determined to be economically beneficial to OGG.

3.1.3 Consolidated Rental Car Facility

Currently, the rental car companies are located away from the terminal and require a shuttle bus service. The new facility will feature an electric tram built on a rail system to provide quick and efficient transportation between the terminal and rental car counters.

The CONRAC will house more than a dozen rental car companies in one location that will be closer to the main terminal. The new CONRAC will be a three-level structure, encompassing rental car offices, customer service counters, ready and return rental car spaces, and Quick-Turn-Around (QTA) areas with fuel and car wash facilities to service rental car fleets. There will be nearly 3,800 parking stalls dedicated to the rental car companies, plus another 700 stalls dedicated to employee parking for a total of nearly 4,500 parking stalls.

The construction on the new CONRAC at OGG started in 2016, and will be completed in approximately 3.5 years.

3.1.4 Irrigation along Keolani Place

There are two water accounts at Keolani Place (Account numbers 3884106640 and 7174112499) that are used for irrigation. Based on average billing data presented in Table 3-1, potable water consumption at these two locations are 154.2 and 109.1 (1,000 gallons/month), respectively. This is approximately 6 percent of the total water volume based on recent billing records. Alternative water sources could be implemented for irrigation at these locations.

3.2 Inventory of Wastewater Generation

A map of the wastewater collection system at OGG is presented in Figure 3-3.

Because there is no direct metering of the wastewater discharge volume and flow at each consumer level, typically wastewater billing data is calculated based on potable water consumption. The average wastewater cost for the 12-month period from October 2015 to September 2016, is approximately $22,000 per month, as compared to $26,000 per month for potable water charges. Some water accounts listed in Table 3-1 are irrigation meters with no wastewater charges.

Legend

Sewer Line

N

0 750 1,500
Feet

Figure 3-3
OGG Wastewater System
Kahului Airport
Kahului, HI

Imagery Source: ©2014 Google
Modifications have been made

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3.3 Potential Projects to Use Alternative Water Sources at OGG

The following is a listing of potential sources of alternative water and potential users of that water.

Table 3-2. Summary of Proposed Water Supply Alternatives at OGG

Potential Water Sources	**Potential Facilities**
Onsite Scalping Plant	Cooling Tower
	CONRAC Facility
	Irrigation
Kahului WRF (R-1 Water)	Cooling Tower
	CONRAC Facility
	Irrigation
Kahului WRF (R-2 Water)	Irrigation
Brackish Wells	Cooling Tower
	CONRAC Facility
	Irrigation
Storm water Harvesting	Irrigation
Rainwater Harvesting	Irrigation

3.4 Potential Alternative Water Sources and Users of Non-Potable Water Sources

3.4.1 Potential Alternative Water Sources

3.4.1.1 Onsite Wastewater Treatment

Currently the OGG wastewater is treated at the Kahului Wastewater Reclamation Facility (WRF). One option for producing recycled water is to construct a scalping WWTP that will divert a portion of the airport wastewater from the trunk sewer to an onsite treatment facility. The withdrawn wastewater can be treated to specific standards depending on its use, and non-reclaimable water, containing biosolids is returned to the trunk sewer. Solids from the scalping may be able to be discharged to the trunk sewer, but this would need to be analyzed for potential odor issues.

Scalping plants require less space than conventional WWTPs because a solids treatment process is not required. MBRs are often used in scalping plants because of their small footprint and ability to produce high quality tertiary treated effluent. Typically, the scalping plant is best located near the reuse demand area because of hydraulic practicality to reduce pumping costs, and for minimizing the necessary conveyance infrastructure. The location for the scalping plant at OGG, as shown in Figure 3-4, would be best located nearby to a main sewer line and point of use, such as the CONRAC facility or the cooling tower.

Legend
- Large Potable Water User
- Scalping Plant Potential Location
- Sewer Line

N
0 350 700 Feet

Imagery Source: ©2014 Google
Modifications have been made

Figure 3-4
Scalping Plant Potential Locations
Kahului Airport
Kahului, HI

ch2m

\\galt\Proj\HDOT\675792\MapFiles\Exhibit1_OGG_Potential_Scalping_Plants.mxd 1/11/2017 AESPEJO

Instead of treating wastewater directly, an onsite polishing plant could also be used to treat R-2 water to R-1 quality. The Kahului WRF is currently rated for R-2 production, but does not have a recycled water distribution system to reach customers, making this option less feasible. Most of the WRF R-2 water is disposed of through underground injection wells. A smaller portion is used on the WRF property for landscape irrigation or is transported via truck for use on construction sites. If R-2 water was conveyed to OGG, a portion of that water could be diverted and treated to R-1 quality. This option would allow for the use of both R-1 and R-2 water types generating a wide range of uses for recycled water at the airport. Compared to R-2 requirements, R-1 water must be filtered and further disinfected. A future option may be to receive R-1 water directly from the Kahului WRF. A 2015 study by the County of Maui investigated expanding the Kahului WRF recycled water production to include R-1 water and an R-1 water distribution system as explained further in Section 3.4.1.2.

3.4.1.2 Offsite Wastewater Treatment

Currently the OGG wastewater is treated at the Kahului WRF. The Kahului WRF has a design peak wet weather flow rate of 15.8 MGD and a design average dry weather flow rate of 7.9 MGD. The WRF effluent is rated for R-2 water use. Most of the WRF R-2 water is disposed of through underground injection wells. A smaller portion is used on the WRF property for landscape irrigation or is transported via truck for use on construction sites.

However, a future option may be to receive R-1 water directly from the Kahului WRF. A 2015 study by the County of Maui investigated expanding the Kahului WRF recycled water production to include R-1 water and an R-1 water distribution system. The proposed recommendation in the 2015 study includes wastewater treatment methodologies to bring all incoming wastewater to R-1 quality, and storage methodologies to meet R-1 water demands (Brown and Caldwell, 2015). The 2015 study also includes a potential R-1 distribution line to the OGG, recreated in Figure 3-5.

Important design and regulatory considerations for obtaining R-1 and/or R-2 recycled water from the Kahului WRF includes the following:

- Onsite regulatory requirements would be minimal for R-1 and R-2 water because of regulatory demands being met at the WRF site. Producing R-1 from a polishing plant onsite at the OGG would require R-1 treatment regulations to be met as documented in 11-62-26.
- Effects of salt air corrosion and tsunamis have prompted discussion of a proposal to construct a new WRF further inland. This may have an effect on the long-term function and flows to the Kahului WRF. This possibility is addressed in the R-1 Recycled Water Study (Brown and Caldwell, 2015).

Legend

- Large Potable Water User
- Force Main
- Sewer Line
- Proposed R-1 Distribution to OGG (County of Maui, 2015)

Imagery Source: ©2014 Google
Modifications have been made

N

0 350 700 Feet

Figure 3-5
Proposed R-1 Distribution
Kahului Airport
Kahului, HI

ch2m

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3.4.1.3 Well Water and Desalination Treatment

A number of wells are located either on or near OGG property and may be potential sources for water. Two brackish wells regulated by the DOT-A are located on the northern-side of the airport (Well F in Figure 3-6), and at the new CONRAC facility (Well D in Figure 3-6). Both wells share the same water quality, containing approximately 1,000 parts per million (ppm) chloride. If the wells are used as a water source, desalination treatment would need to be implemented before use. Currently the airport draws irrigation water from a well owned by Alexander and Baldwin (Well C in Figure 3-6). The Kahului WRF may use well water to support water demands (Well A in Figure 3-6).

Data for nearby wells was obtained through the *Hawai'i State Water Wells* database and are shown in Figure 3-6. Parameters such as type of well, depth of well, and head are listed in this database, however sampling would be needed to characterize the water quality of each well in order to determine to what extent and at what cost desalination and/or blending with lower salinity water is required to provide a quality suitable for use. Blending to reduce TDS has been practiced by a number of golf courses, resorts, and parks in Central Maui (DLNR Commission on Water Resource Management, 2013). The location of the desalination facility would depend on the location of the supply well(s) and the point(s) of use. Open intake seawater desalination is also an option at OGG; however, a groundwater facility would be less expensive to implement and operate. Therefore, as long as the production capacity of the groundwater wells is sufficient, this option should be explored fully before developing a seawater alternative.

3.4.1.4 Storm Water Collection and Treatment

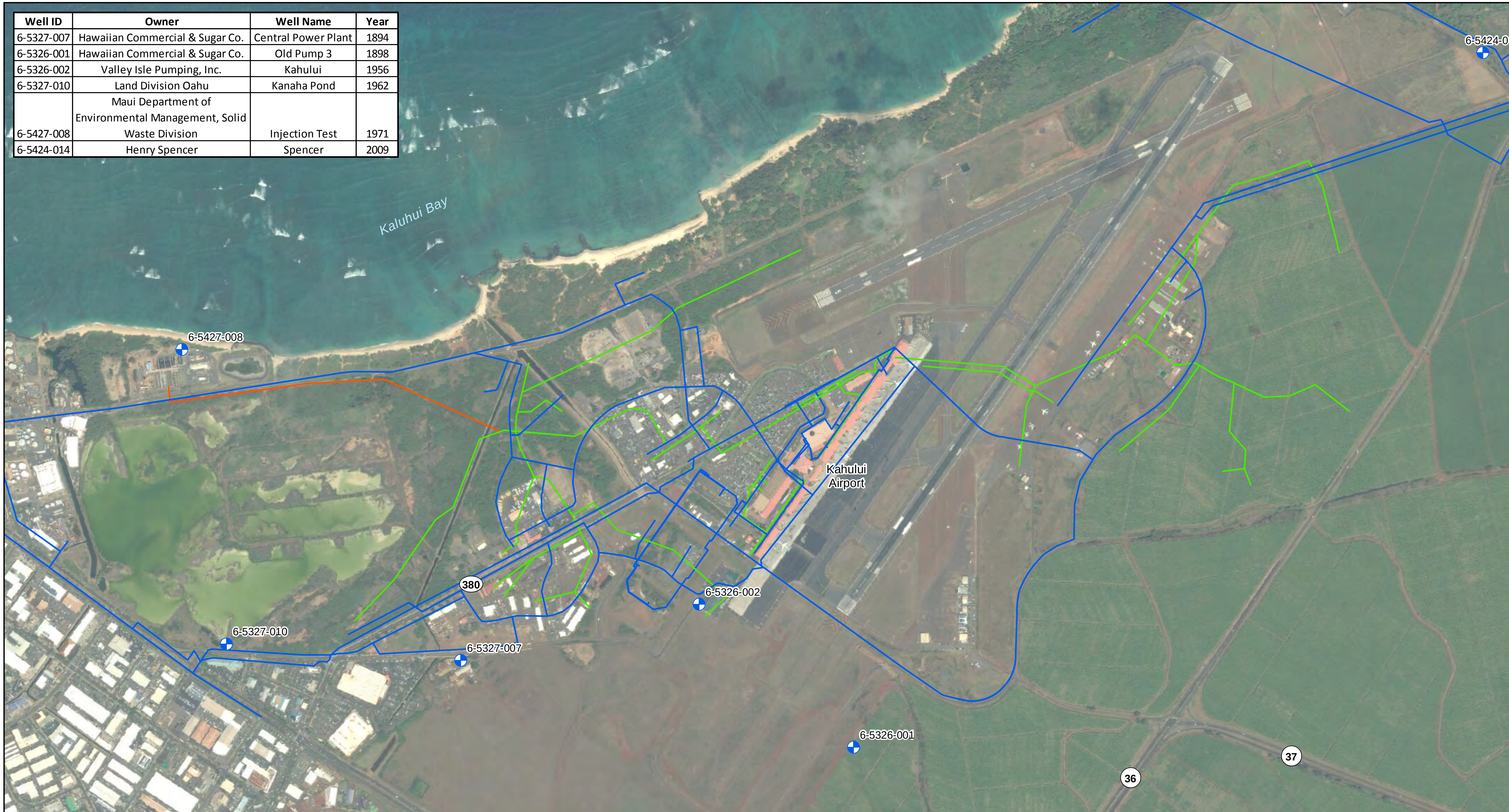
Two storm water channels on the northwest side of the OGG converge and discharge into the Kahului Bay. Storm water may be a potential source of reuse water for the OGG depending on the quantity and quality, and variability of both. The San Diego International Airport is currently developing methods for capturing and reusing storm water for non-potable airport operations. The quantity available likely fluctuates by the season, and further hydrological storm water flows and historical precipitation data would support decisions regarding available quantity for use and the amount of storage required to provide a consistent supply. In addition, water quality needs to be evaluated before use to determine necessary treatment requirements.

If quantity and quality of storm water are feasible for use, one option is to use a holding pond for the storm water before treatment to support settling of particulates. Currently the Kahului WRF has an effluent holding pond as shown in Figure 3-7. Similarly, the collected storm water could be held in a pond before use at OGG. A region between the storm water channels and the WRF may be able to support a pond for this purpose. The feasibility of storm water use depends on the availability of water. The following activities would support a feasibility study:

- Surface water modeling of storm water channels and other water capturing areas, such as runway runoff water, to evaluate the volume of water that may be recovered
- Investigation of methods to increase storm water detention such as constructing lined basins to reduced water loss to pervious soils and constructing underground or covered basins to reduce evaporation loss
- Storm water conveyance modeling to evaluate hydraulic pumping requirements to transport storm water to the holding pond and to water users
- Water quality evaluation to determine necessary treatment before water use for irrigation

The storm water would likely require some treatment or mixing with high quality water before use. This mixing water could be R-1 water or rainwater that could be collected seasonally as described in the next section.

Well ID	Owner	Well Name	Year
6-5327-007	Hawaiian Commercial & Sugar Co.	Central Power Plant	1894
6-5326-001	Hawaiian Commercial & Sugar Co.	Old Pump 3	1898
6-5326-002	Valley Isle Pumping, Inc.	Kahului	1956
6-5327-010	Land Division Oahu	Kanaha Pond	1962
6-5427-008	Maui Department of Environmental Management, Solid Waste Division	Injection Test	1971
6-5424-014	Henry Spencer	Spencer	2009



Legend

- Historic Well
- Force Main
- Potable Water
- Sewer Line

N

0 500 1,000
Feet

Figure 3-6
Historic Well Locations
Kahului Airport
Kahului, HI

Imagery Source: Esri, 2016

\\galt\Proj\HDOT\675792\MapFiles\Exhibit4_OGG_Historic_Well_Locations.mxd 1/11/2017 AESPEJO

Legend

- Kahului WRF
- Stormwater Channel
- Force Main
- Sewer Line
- Existing Effluent Holding Basin
- Potential Region for Stormwater Holding Basin

Imagery Source: Esri, 2016

N

0 500 1,000 Feet

Figure 3-7
Potential Region for Stormwater Holding Basin
Kahului Airport
Kahului, HI

ch2m

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3.4.1.5 Rainwater Harvesting

Rainwater harvesting during high precipitation months may provide a viable source of water for R-1 water activities. The highest precipitation months are from October through April, and low precipitation months are from May through September. From 2000 to 2016, average annual rainfall was approximately 16.2 inches. The rainwater collected depends on the surface area used for the rainwater harvesting system and roofing material of the airport buildings. Assuming an average of 16.2 inches per year falling on impervious roofing material, approximately 9,000 gallons of water can be collected per 1,000 square feet of roofing. Locations for possible rainwater harvesting locations are shown in Figure 3-8.

The feasibility of rainwater use depends on the availability of water. The following activities would support a feasibility study:

- Rainwater modeling of potential collection locations and other water capturing areas, such as runway runoff water, to evaluate the volume of water that may be recovered
- Investigation of methods to increase rainwater detention such as constructing lined basins to reduced water loss to pervious soils and constructing underground or covered basins to reduce evaporation loss
- Rainwater conveyance modeling to evaluate hydraulic pumping requirements to transport rainwater to the holding pond and to water users
- Water quality evaluation to determine necessary treatment before water use for irrigation

The rainwater would likely require little to no treatment or mixing with high quality water before use for irrigation or other non-potable activities.

Legend
- Potential Rainwater Harvesting Location
- Potable Water
- Sewer Line

N

0 350 700
Feet

Imagery Source: ©2014 Google
Modifications have been made

Figure 3-8
Potential Rainwater Harvesting Locations
Kahului Airport
Kahului, HI

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3.4.2 Potential Users of Alternative Water Sources

3.4.2.1 Cooling Tower

OGG uses a cooling tower on the southeastern side of the property, to provide air conditioning to the airport. In evaporative cooling systems, water lost from evaporation and blowdown has to be replenished using make-up water in order to prevent the buildup of scale and biological matter in the cooling tower. Recycled water may be used in place of potable water to replenish the cooling tower system. Using recycled water in the OGG cooling tower would require a number of optimization steps to ensure that the cooling tower is well-equipped and resilient to making the switch to recycled water. See Section2.4.2.1 for additional information on cooling tower make-up water requirements.

3.4.2.2 Consolidated Rental Car Facility

The CONRAC that is to be completed in 2019 will contain more than a dozen car rental companies and nearly 4,500 parking stalls. QTA areas will provide fuel and car wash facilities to service rental car fleets. Car rental and washing facilities are traditionally large water users, and provide an opportunity to use recycled water in place of potable water.

One option is for the CONRAC facility to receive R-1 water from an onsite water scalping plant, or directly from the Kahului WRF, as described previously. R-1 water would be used over R-2 water because of the high likelihood of human contact with the recycled water. An additional option is to employ an onsite water treatment system at the car wash facility to produce water for reuse onsite. See Section 2.4.2.2 for additional discussion of alternative water supply sources for car wash facilities.

3.4.2.3 Irrigation along Keolani Place

Potable water consumption along Keolani Place is approximately 6 percent of the total volume of potable water used at OGG. Using recycled water for landscape irrigation is an option that has been pursued by other large water users across the state. Unlike water reuse applications for cooling towers and car wash facilities, water withdrawal from brackish wells for irrigation purposes has been common practice in Hawaii. Parks, resorts, and golf courses in Maui, such as Maui Research & Technology Park, Makena North Golf Course, and The Challenge at Manele (on the Island of Lanai) have used brackish water extracted from wells for irrigation. Many of these recreational areas mix the brackish water before irrigation to reduce negative effects of high salinity water on their landscapes.

Seasonal alternatives to well water are storm water and rainwater. During high precipitation months, detention and storage of runoff water and rainwater may provide a significant volume of water for irrigation purposes.

3.5 Narrative Description of Alternatives

3.5.1 Overview of Alternatives

The following narratives provide an overview of the opportunities for OGG to use alternative water sources for non-potable uses including irrigation, cooling tower operation and car washing. While each of the alternatives highlight alternative water possibilities from a wide range of sources and treatment technologies, each option requires further investigation and optimization for proven feasibility and efficiency.

3.5.2 Alternative 1: R-1 Production through an On-site Scalping Plant

Currently the OGG wastewater is treated at the Kahului WRF. One option for producing recycled water is to construct a scalping wastewater treatment plant that will divert a portion of the airport wastewater from a trunk sewer to an onsite treatment facility. The withdrawn wastewater can be treated to specific standards depending on its use, and non-reclaimable water, containing biosolids, is returned to the trunk sewer.

Scalping plants require less space than conventional wastewater treatment plants because a solids treatment process is not required. MBRs are often used in scalping plants because of their small footprint and ability to produce high quality tertiary treated effluent. Typically, the scalping plant is best located near the reuse demand area because of hydraulic practicality to reduce pumping costs, and for minimizing the necessary conveyance infrastructure. A potential location for the scalping plant at OGG, as shown in Figure 3-9, would be best located near a main sewer line and the point of use, such as the CONRAC facility or the cooling tower.

The proposed scalping plant would provide oxidation, filtration, and disinfection treatment for the production of R-1 water. From the scalping plant, the R-1 water would be piped to R-1 water users such as the cooling tower and/or the CONRAC facility. An R-1 holding tank could also potentially be used to store treated R-1 water to be used during high-demand hours. Following R-1 water use in at the cooling tower and CONRAC facilities, wastewater would enter the sewer lines, indicated by the green lines in Figure 3-9.

Legend
- Large Potable Water User
- Scalping Plant Potential Location
- Sewer Line

N

0 350 700 Feet

Figure 3-9
Scalping Plant Potential Locations
Kahului Airport
Kahului, HI

Imagery Source: ©2014 Google
Modifications have been made

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3.5.3 Alternative 2a: Receive R-1 Water from Kahului Wastewater Reclamation Facility

As discussed in Section 2.4.1.2, the County of Maui is investigating treating water at the Kahului WRF to R-1 quality. A reuse pipeline could serve the airport as shown in Figure 3-5. Potential Facilities include the cooling tower, the CONRAC facility, and irrigation along Keolani Place.

3.5.4 Alternative 2b: Receive R-2 Water from Kahului Wastewater Reclamation Facility

Currently the Kahului WRF produces R-2 water. This water can be conveyed to the OGG and used for irrigation along Keolani Place. Further onsite treatment using a polishing plant could produce R-1 water that could be utilized at the cooling tower and the CONRAC facility. The alignment of a potential pipeline is shown in Figure 3-5 and the polishing plants could be located in the same locations shown in Figure 3-5 (Scalping Plants).

3.5.5 Alternative 3a: Desalination Water Production from Well Water for Potable Usage

Wells near the new CONRAC facility (Well D in Figure 3-6) will be used for groundwater desalination. The new wells contain brackish water, and will require desalination and disinfection prior to potable use. However, further water quality data, as well as production capacity, are required before knowing the feasibility of developing these wells to meet the maximum month potable demand at OGG of 120 gpm. Extracted brackish well water would undergo RO and disinfection treatment near the wells, followed by conveyance to an optional storage tank and connection with the existing potable system. Chemical addition (post treatment) will also be required to make the desalinated water compatible with distribution and end use infrastructure (non-corrosive). This footprint of this facility would be approximately 25 meters by 45 meters. Figure 3-10 presents a potential desalination system at OGG.

Legend
- Force Main
- Potable Water
- Proposed Potable Water Line
- Sewer Line
- Well/Treatment Facility

Imagery Source: Esri, 2016

N

0 250 500 Feet

Figure 3-10
Potential Desalination System
Kahului Airport
Kahului, HI

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3.5.6 Alternative 3b: Desalination Water Production from Well Water for Irrigation

Similar to Alternative 3a, this project follows the examples of nearby properties that use brackish groundwater for irrigation purposes. Typically, the brackish water is treated through desalination and then the treated water is blended with brackish groundwater to yield a product that is within the tolerance level of the irrigated vegetation. This option is less expensive than treating all the water to a high-quality level.

3.5.7 Alternative 4: Storm Water Collection for Irrigation

Two storm water channels on the northwestern side of OGG converge and discharge into the Kahului Bay. This storm water may be a potential source of reuse water for OGG depending on the quantity and quality of this water. The San Diego International Airport is currently developing methods for capturing and reusing storm water for non-potable airport operations. If quantity and quality of storm water are feasible for use, one option is to use a holding pond for the storm water before treatment to support settling of particulates. Currently the Kahului WRF has an effluent holding pond as shown in Figure 3-11. Similarly, the collected storm water could be held in a pond before use for irrigation at OGG. A region between the storm water channels and the WRF may be able to support a pond for this purpose.

The feasibility of storm water use depends on the availability of water. The following activities would support a feasibility study:

- Surface water modeling of storm water channels and other water capturing areas, such as runway runoff water, to evaluate the volume of water that may be recovered
- Investigation of methods to increase storm water detention such as constructing lined basins to reduced water loss to pervious soils and constructing underground or covered basins to reduce evaporation loss
- Storm water conveyance modeling to evaluate hydraulic pumping requirements to transport storm water to the holding pond and to water users
- Water quality evaluation to determine necessary treatment before water use for irrigation

The storm water would likely require some treatment or mixing with high quality water before use for irrigation. The blending water could be R-1 water or rainwater that could be collected seasonally.

Legend

- Kahului WRF
- Stormwater Channel
- Force Main
- Sewer Line
- Existing Effluent Holding Basin
- Potential Region for Stormwater Holding Basin

Imagery Source: Esri, 2016

N

0 500 1,000 Feet

Figure 3-11
Potential Region for Stormwater Holding Basin
Kahului Airport
Kahului, HI

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3.5.8 Alternative 5: Rainwater Collection for Irrigation

Rainwater Harvesting → Holding Pond → Scalping Plant → Irrigation

Rainwater harvesting during high precipitation months may provide a viable source of water for non-potable water activities. The highest precipitation months are from October through April, and low precipitation months are from May through September. From 2000 to 2016, average annual rainfall was approximately 16.2 inches. The rainwater collected depends on the surface area used for the rainwater harvesting system and roofing material of the airport buildings. Assuming an average of 16.2 inches per year falling on impervious roofing material, approximately 9,000 gallons of water can be collected per 1,000 square feet of roofing. Locations for possible rainwater harvesting locations are shown in Figure 3-12.

The feasibility of rainwater use depends on the availability of water. The following activities would support a feasibility study:

- Rainwater modeling of potential collection locations and other water capturing areas, such as runway runoff water, to evaluate the volume of water that may be recovered
- Investigation of methods to increase rainwater detention such as constructing lined basins to reduced water loss to pervious soils and constructing underground or covered basins to reduce evaporation loss
- Rainwater conveyance modeling to evaluate hydraulic pumping requirements to transport rainwater to the holding pond and to water users
- Water quality evaluation to determine necessary treatment before water use for irrigation

The rainwater would likely require little to no treatment or mixing with high quality water before use for irrigation or other non-potable activities.

Legend

- Potential Rainwater Harvesting Location
- Potable Water
- Sewer Line

N

0 350 700
Feet

Figure 3-12
Potential Rainwater Harvesting Locations
Kahului Airport
Kahului, HI

Imagery Source: ©2014 Google
Modifications have been made

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3.6 Regulatory and Contractual Assessment

Table 3-3. Summary of Potential Regulatory and Contractual Issues

Potential Water Sources	Potential Facilities	Regulatory/Contractual Issues
Onsite Scalping Plant	Cooling Tower CONRAC Facility Irrigation	HDOH Recycled Water Guidelines
Kahului WRF (R-1 Water)	Cooling Tower CONRAC Facility Irrigation	HDOH Recycled Water Guidelines
Kahului WRF (R-2 Water)	Irrigation	HDOH Recycled Water Guidelines
Brackish Wells	Cooling Tower CONRAC Facility Irrigation	N/A
Storm water Harvesting	Irrigation	N/A
Rainwater Harvesting	Irrigation	N/A

Kona International Airport at Keahole (KOA)

KOA is the largest airport on Hawaii Island and is owned and operated by the DOT. KOA is located in the North Kona district and is west of Queen Kaahumanu Highway, approximately 7 miles north of Kailua-Kona, Hawaii. KOA is one of four airports on the island that services interisland, mainland, and international carriers, and is located on the west side of the Island of Hawaii and. KOA is situated on approximately 3,450 acres of land. The airport has a single runway that is 11,000 feet long and 150 feet wide. The airport averages approximately 8,000 passengers per day.

The passenger terminals for interisland and overseas travel are centrally located and divided into two terminals (north and south). The airport administration building is located north of these terminals. Further north beyond the administration building are the international arrival facilities.

The terminal area is provided vehicle access from Queen Kaahumanu Highway through the airport access road (Keahole Street). The terminal roadway loop (peripheral road) connects with Keahole Street and provides access to the terminal area.

This section provides an overview of the current water/wastewater system at KOA.

4.1 Inventory of Water Use

KOA's water distribution system is supplied by various meters throughout the airport area. Two main water lines, 12 inches and 16 inches, feed the airport area via the Airport Access Road. A map of the water distribution system is presented in Figure 4-1. Per water meter accounts, there are 33 water consuming entities.

Legend
Potable Water

0 500 1,000
Feet

Figure 4-1
KOA Water Distribution System Map
Kona International Airport
Kailua-Kona, HI

Imagery Source: ©2014 Google
Modifications have been made

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Historical master meter data for potable water were provided from 2010 to 2015 by monthly, as summarized in Table 4-1. These data indicated from 2010 to 2015, the average potable water consumption at KOA is 59,411 kgal/year, or 0.16 MGD. The average water cost for the same time period is approximately $300,288 per year.

Table 4-1. Historical Water Usage at KOA – Potable Water, in 1,000 gallons

	2010	2011	2012	2013	2014	2015
January	4,940	4,178	4,418	4,809	3,814	6,254
February	4,552	5,204	5,234	3,225	2,845	6,129
March	5,200	4,694	4,037	2,884	4,032	5,286
April	5,233	5,776	4,248	3,960	4,380	6,472
May	4,504	4,999	5,014	4,120	3,115	4,640
June	4,852	3,864	4,497	4,387	4,333	5,222
July	5,384	3,780	5,200	4,493	6,286	5,631
August	5,711	3,774	5,995	4,014	5,197	6,521
September	5,035	4,192	5,221	5,548	4,915	8,271
October	6,133	4,009	4,708	6,388	6,205	7,165
November	5,421	3,950	6,207	3,439	3,148	7,496
December	4,993	4,804	3,713	4,035	6,023	8,109
Total	**61,958.0**	**53,224.0**	**58,492.0**	**51,302.0**	**54,293.1**	**77,196.0**
Average	**59,411**					

DOT-A provided historic water meter readings at KOA during the period of July 2002 to June 2016 for all the sub-meters that serves each individual water consumer. The readings were taken monthly at each meter location. The rental car facilities are on individual meters and the DOT-A does not receive records of their usage. Each facility does have its own car wash recycling system. Rental car facilities include Alamo, Avis, Dollar, Budget, Enterprise, Hertz, National, and Thrifty.

A summary of potable water usage data is provided in Table 4-2. The Table 4-2 ranked all the meter locations by the highest average potable water usage for the most recent 12 months (September 2015 to August 2016) for all sub-meters. Based on the historic water billing data for the last 12 months, the average water consumption across the KOA system was calculated to be 6,950 (1,000 gallons/month), or 0.23 MGD, as presented in Table 4-2.

The data presented in Table 4-2 indicates the largest water users at KOA are the south side irrigation system (near the old Aircraft Rescue Fire Fighting [ARFF] facility), Hawaiian Airlines, the WWTP, and Aloha Airlines. Usage of potable water by the WWTP is supplemental water being added to the reuse tank to provide adequate volume for irrigation along the Airport Access Road.

The following locations are feasible water reuse alternatives because they are currently one of the largest water users at the Kona Airport:

- South irrigation/ARFF (old ARFF)
- HA Water (Hawaiian Water)
- WWTP

Table 4-2. Summary of Water Usage at KOA – Sub-meters, in 1,000 gallons

Rank	Meter No.	Tenant	Jun-16	May-16	Apr-16	Mar-16	Feb-16	Jan-16	Dec-15	Nov-15	Oct-15	Sep-15	Aug-15	Jul-15	12-Month Average	Note
1	W0097948914	S. Irrigation/ARFF (old ARFF)	3,746	2,451	2,533	2,706	2,347	2,293	2,844	2,657	2,754	3,108	2,460	2,073	2,664	
2	W0005003030	HA Water	1,134	959	1,294	1,056	2,782	2,640	2,767	2,575	2,404	2,282	1,999	1,527	1,952	
3	W0017013869	WWTP	1,382	971	534	419	600	584	967	861	575	1,569	670	504	803	
4	W0005003029	AQ Water (Aloha)	662	525	568	669	534	437	496	420	462	444	423	477	510	
5	W0019880032	N. Irrigation	510	288	354	386	302	239	262	330	156	130	151	210	277	
6	W0036951530	S. Cargo/Commuter	187	164	173	192	185	160	212	165	178	157	158	201	178	
7	W0060003302	Ground Trans	142	126	130	149	133	127	146	129	166	162	146	166	144	
8	W0017013850	Administration	81	80	128	138	129	126	166	138	139	142	125	136	127	
9		KOA New ARFF	66	44	76	85	63	77	76	60	80	88	64	82	72	
10	W0000207238	USDA/Security	35	46	38	44	65	97	54	71	85	23	96	72	61	
11	W0040445988	CAP/KAI	35	28	28	40	32	80	33	22	16	29	43	26	34	
12	W0017014730	HAL Cargo/Tower	36	26	42	23	31	31	24	27	33	32	43	33	32	
13	W0009308729	ARFF Training Pit	1	0	0	0	182	0	0	1	48	32	48	66	32	
14	W0098148505	Maintenance Shop	28	23	30	19	19	23	20	15	16	17	16	20	21	
15	W0017014704	T-Hangers	7	6	6	8	8	57	10	10	18	-	18	17	15	
16	W0031543008	N. Cargo	8	8	12	12	13	9	16	9	28	11	11	11	12	
17	W0040592087	Alamo	33	4	5	5	5	5	5	4	5	22	44	4	12	
18	W0040591908	Parking Lot Booth	3	2	2	3	3	2	3	2	2	2	4	3	3	
19	W0060003308	U-Drive Baseyard	0	0	0	9	0	15	0	0	0	0	0	0	2	
20	W0002114032	AQ Fire	0	1	1	0	1	0	8	0	0	2	2	3	2	
		Total – Sub-meters	**8,097**	**5,752**	**5,954**	**5,964**	**7,435**	**7,002**	**8,109**	**7,496**	**7,165**	**8,253**	**6,521**	**5,620**	**6,950**	

4.1.1 South Irrigation/ARFF (old ARFF)

The majority of the landscaping is being irrigated in the terminal area and portions of the peripheral road. The water meter is located at the old ARFF building.

4.1.2 HA Water (Hawaiian Airlines)

Awaiting information from KOA.

4.1.3 Wastewater Treatment Plant

The WWTP is an R-1 facility that supplies reuse water for landscape irrigation at the treatment plant, pump station, and the airport access road. The reuse water is also used for wash down water at the treatment plan. The WWTP consists of a headworks, oxidation ditch, secondary clarifier, sand filters, and ultra-violet disinfection. The daily flow varies between 30,000-45,000 gallons per day and is blended with potable water in an effluent tank prior to distribution. An infiltration basin is used for backup disposal when R-1 quality is not met. Currently, the quantity of reuse water does not meet the landscape irrigation demand. Therefore, the quantity of potable water is substantial as shown in Table 4-3.

Table 4-3. Historical Water Usage at KOA WWTP – Water, in million gallons

	2014			2015			2016		
	WWTP Influent	Reuse Water	Potable Water	WWTP Influent	Reuse Water	Potable Water	WWTP Influent	Reuse Water	Potable Water
January	1.321	1.479	0.4354	1.358	1.3	0.906	1.592	1.552	0.646
February	1.184	1.291	0.468	1.274	1.068	0.733	1.517	1.338	0.598
March	1.287	1.126	0.5742	1.543	1.581	0.498	2.126	1.91	0.322[a]
April	1.141	1.075	0.8079	1.277	1.398	0.647	1.744	1.617	0.001[a]
May	1.054	1.145	0.9384	1.332	1.488	0.726	1.458	1.436	1.042
June	1.042	1.253	0.6493	1.506	1.617	0.632	1.407	1.413	1.278
July	1.229	1.241	0.7412	1.546	1.779	0.457	1.518	1.513	0.889
August	1.112	1.323	0.607	1.523	1.027	0.829	1.464	0.781	1.494
September	1.09	1.354	0.786	1.165	0.1	1.383	1.412	0	2.118[b]
October	1.179	1.275	0.988	1.435	1.657	0.595	1.548	1.327	0.967
November	1.325	0.474	0.899	1.346	1.22	0.98	--	--	--
December	1.295	1.515	0.741	1.365	1.602	0.819	--	--	--

a. Main water meter for the WWTP was not recording flow from March 20 to April 29.

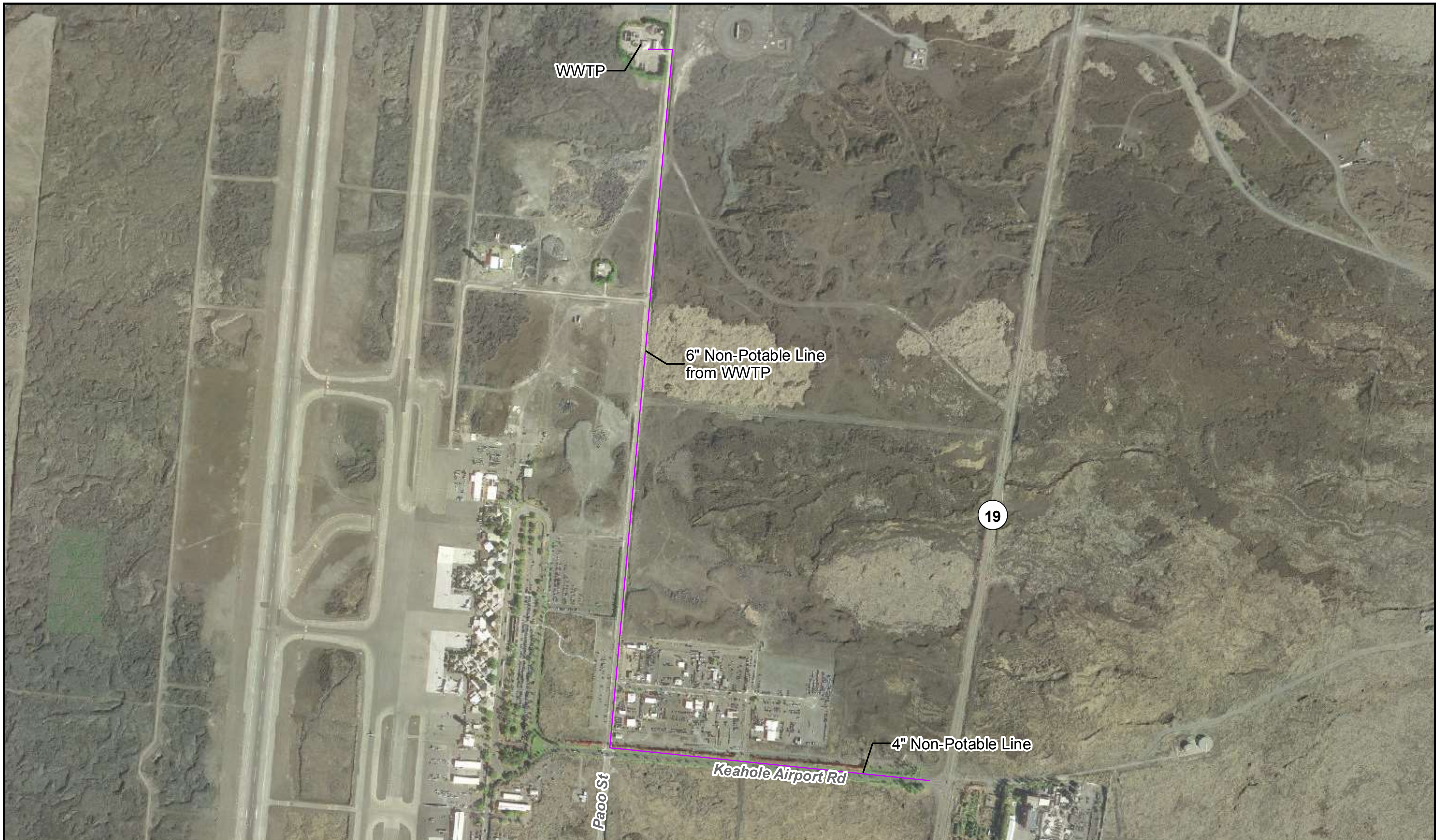
b. High usage because of clarifier sludge pump issue and filter cleaning, causing diversion to infiltration basin.

4.1.4 AQ Water (Aloha)

Awaiting information from KOA.

4.2 Inventory of Wastewater Generation

All wastewater generated at KOA discharges to the DOT-A 12-inch diameter sewer line located along the Peripheral Road and is ultimately processed at the DOT-A KOA WWTP to R-1 effluent quality. A majority of the KOA wastewater system consists of gravity pipes. There are two WWPSs and FMs at KOA. A map of the wastewater collection system is presented in Figure 4-2.



Legend

Non-Potable Water Line

0 550 1,100
Feet

Imagery Source: ©2014 Google
Modifications have been made

Figure 4-2
KOA Non-Potable Water Distribution System
Kona International Airport
Kailua-Kona, HI

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The main WWPS is located north-east of the terminal area and feeds the WWTP with a 6-inch FM. This main pump station was built at the same time as the WWTP. The pump station is a package Smith & Loveless drywell/wet well facility. Pump data from this pump station is listed in Table 4-4.

Table 4-4. Main pump data at WWPS

	WWPS		
	Pump 1	**Pump 2**	**Pump 3**
Pump Manufacturer and Model Number	Smith & Loveless 4B-2A	Smith & Loveless 4B-2A	Smith & Loveless 4B-2A
Other Manufacturer Identifier	-	-	-
Serial Number	-	-	-
Pump Type	Vertical Non-Clog	Vertical Non-Clog	Vertical Non-Clog
Pump Size	-	-	-
TDH	64 ft	64 ft	64 ft
Year Installed	2001	2001	2001
Flow	350 gpm	350 gpm	350 gpm
Impeller Diameter	8-1/2 inches	8-1/2 inches	8-1/2 inches
Motor	20 HP	20 HP	20 HP

TDH = Total Dynamic Head

The smaller WWPS is located on the southern side of the airport area and feeds a sewer discharge manhole with a 1.5-inch FM. This sewer manhole is located on the southern side of the peripheral road. Pump data from the smaller pump station is listed in Table 4-5.

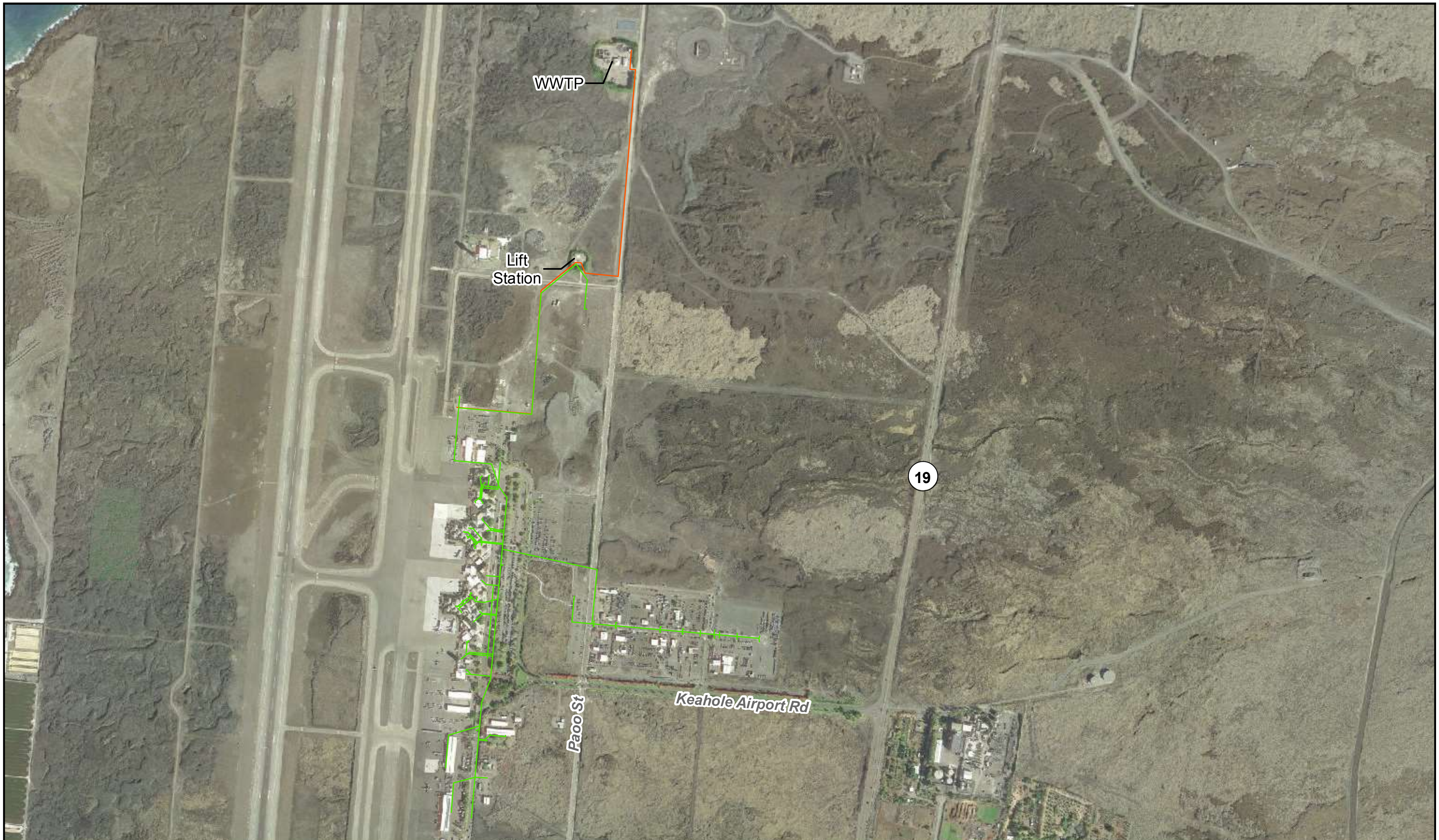
Table 4-5. Smaller Pump Data at WWPS

	WWPS	
	Pump 1	**Pump 2**
Pump Manufacturer and Model Number		
Other Manufacturer Identifier		
Serial Number		
Pump Type	Submersible Grinder	Submersible Grinder
Pump Size		
TDH	63 ft	63 ft
Year Installed	2002	2002
Flow	20 gpm	20 gpm
Impeller Diameter		
Motor	2 HP	2 HP

4.3 Inventory of Existing Non-potable Water Sources

4.3.1 Existing Recycled Water System

The existing WWTP produces R-1 water for washdown water at the WWTP and landscape irrigation at the WWTP, WWPS, and Airport Access Road. A map of the recycled water system is presented in Figure 4-3.



Legend

Force Main

Sewer Line

0 625 1,250 Feet

Imagery Source: ©2014 Google
Modifications have been made

Figure 4-3
KOA Wastewater Collection System
Kona International Airport
Kailua-Kona, HI

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4.3.2 Storm Water and Rainwater

Currently storm water and rainwater is collected and discharged into injection wells located throughout the KOA area. KOA is located on old lava fields and the porous nature of this material is excellent for drainage. There are over 50 injection wells scattered throughout the airport as shown in Figure 4-4. Many of these injection wells receive storm water and rainwater from smaller areas without the use of defined ditches or pipes. The two largest storm water and rainwater collection areas at the airport are located on the north side of the Peripheral Road. The storm water and rainwater is collected using a system of swales, ditches, piping and bridge culverts.

Employee Parking Lot

The first area collects storm water from the employee parking lot. The storm water sheet flows towards the Peripheral Road and is collected in concrete swales that convey the water north towards an injection well.

Terminal Area

The second area collects rainwater from the roof tops of the terminal area and administration buildings into various drain pipes ranging in size from 6 inches to 30 inches. Storm water is also collected in the parking lot surrounded by the Peripheral Road. The storm water and rainwater is then conveyed in 30-inch drain pipes to the northern side of the Peripheral Road.

Grey Water

The airport administration building does have air conditioning and cooling system; however, the condensate is not enough to warrant reuse opportunities. Separation of grey water piping from existing buildings is also not feasible for reuse. Black water is already treated at the WWTP.

4.3.3 Desalination

The area surrounding KOA could potentially support a groundwater desalination project. The 2010 County of Hawaii Water Supply Report (Fukunaga & Associates, Inc., 2010) noted that the area between Queen Kaahumanu Highway and Mamalahoa Highway would be a good location for brackish wells. A seawater desalination facility is also feasible at KOA, however a groundwater facility would be less expensive to implement and operate. Therefore, as long as the production capacity of the groundwater wells was sufficient, this option should be explored fully before developing a seawater alternative.

4.4 Non-Potable Water Sources and Users of Non-Potable Water Sources

4.4.1 Onsite WWTP

The existing WWTP produces R-1 water for washdown water at the WWTP and landscape irrigation at the WWTP, WWPS, and Airport Access Road. As previously mentioned, the quantity of reuse water from the WWTP isn’t adequate for the landscaping irrigation requirements. A substantial amount of potable water is used to supplement the landscape irrigation demand. A new scalping plant would not be feasible since there is an onsite R-1 WWTP.

Legend

Stormwater Channel

0 225 450
Feet

Figure 4-4
KOA Stormwater Collection Map
Kona International Airport
Kailua-Kona, HI

Imagery Source: ©2014 Google
Modifications have been made

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Legend

Drywell Location

Figure 4-5
KOA Drywell Locations
Kona International Airport
Kailua-Kona, HI

0 250 500
Feet

Imagery Source: ©2014 Google
Modifications have been made

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4.5 Narrative Description of Alternatives

KOA already has a WWTP onsite that produces R-1 water for landscape irrigation. Due to the airport's relatively small size and minimal support facilities, alternatives for reuse are minimized. Blowdown water, washdown water, and air conditioning condensate (minimal) are not used at KOA and therefore are not alternatives for reuse. There is only one chiller onsite; however, the quantity of condensate is minimal. There are many areas such as ticketing, terminal gates, and baggage claim that are not air conditioned. Storm water and rainwater reuse and desalination are the two most feasible alternatives for KOA.

4.5.1 Alternative 1: Storm Water and Rainwater Reuse

The two storm water and rainwater collection areas previously discussed are located near the Peripheral Road (see Figure 4-7). The Kona area in general is fairly dry. The storms that do occur primarily November-March can result in heavy downpours in a relatively short period of time. Sizing of a holding pond or storage tank would need to account for these sudden downpours.

From 1981 to 2010, average annual rainfall was approximately 18.4 inches. The storm water and rainwater collected for reuse depends on the surface area utilized for the storm water system and roofing material of the airport buildings. Assuming an average of 18.4 inches per year falling on impervious roofing material, approximately 11,100 gallons of water can be collected per 1,000 square feet of roofing.

The first area collects surface storm water from the employee parking lot. Rain water sheet flows to the west and into the existing concrete swale. Rain water from the concrete swale could be directed into a subsurface storage tank or a holding pond.

The second area collects rainwater from the roof tops of the terminal area into various drain pipes ranging in size from 6 inches to 30 inches. Storm water from the parking lot surrounded by the Peripheral Road also contributes to these flows. Because of the depth of the existing 30-inch pipe, a pump station and storage tank would probably be required so the treatment unit would not be as deep.

Legend

- Storm Water
- Rain Water Collection Area
- Storm Water Treatment and Storage Area

N

0 150 300 Feet

Figure 4-6
Potential Storm Water Collection System
Kona International Airport
Kailua-Kona, HI

Imagery Source: ©2014 Google
Modifications have been made

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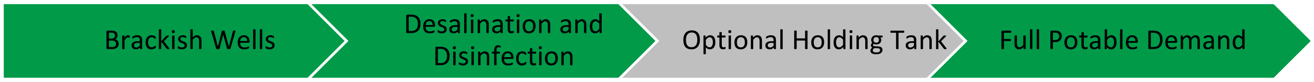
\\galt\Proj\HDOT\675792\MapFiles\FigX_KOA_Storm_Drains_System.mxd 1/16/2017 AESPEJO

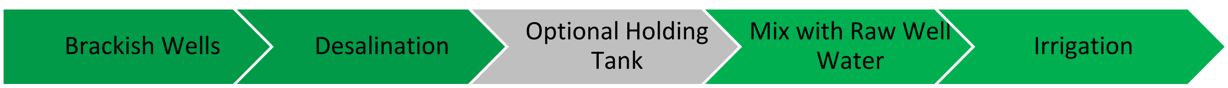
4.5.2 Alternative 2a: Desalination Water



The economies of scale for desalination significantly favor larger water production; therefore, the most cost effective use of desalination water will be to supply the full potable demand of KOA via brackish groundwater.

The area between Queen Kaahumanu Highway and Mamalahoa Highway would be a good location for brackish wells. Ideally, at an elevation above the airport to avoid additional conveyance costs, and outside the influence of any potable water wells in the area. Water would undergo RO and disinfection treatment near the well structure, followed by conveyance to an optional storage tank, and connection with the existing potable system. Chemical addition (post treatment) will also be required to make the desalinated water compatible with distribution and end use infrastructure (non-corrosive). The facility will be sized to supply the maximum month water demand at KOA of 192 gpm. This facility could be located near the existing tanks, east of the airport, for a simpler connection to the existing potable system. This footprint of this facility would be approximately 30 meters by 40 meters. Figure 4-6 presents a potential groundwater desalination system at KOA.

4.5.3 Alternative 2b: Desalination Water Production from Well Water for Irrigation



Similar to Alternative 3a, this project follows the examples of nearby properties that use brackish groundwater for irrigation purposes. Typically, the brackish water is treated through desalination and then the treated water is blended with brackish groundwater to yield a product that is within the tolerance level of the irrigated vegetation. This option is less expensive than treating all the water to a high-quality level.

Figure 4-7
Potential Desalination System Map
Kona International Airport
Kailua-Kona, HI

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4.6 Regulatory and Contractual Assessment

The DOT-A has an existing HDOH UIC permit No. UH-1673J for storm water discharge. A majority of the injection wells are for smaller storm drainage areas.

The DOT-A has an existing HDOH wastewater reuse permit No. R-165 for landscape irrigation at the WWPS, WWTP, and airport access road.

Hilo International Airport (ITO)

Known as General Lyman Field before 1989, Hilo International Airport (ITO) occupies 1,007 acres approximately 2 miles east of Hilo, on the eastern shore of the Island of Hawaii. ITO has two runways that are used for both air carrier and general aviation operations. The passenger terminal complex, including commuter facilities, is at the southern edge of the airport and is served by an access road from Kekuanaoa Street. ITO averages 4,500 passengers per day.

General aviation facilities are located along the eastern edge of the crosswind runway, also served by the terminal access roadway. A parking apron for transient military aircraft is provided at the western edge of the runway.

According to the Hawaii Airports Modernization Program, ITO generally has adequate airfield and terminal capacity to accommodate forecast demands and needs, but a number of maintenance and improvement projects are needed for better energy-efficient equipment and overall passenger comfort experience. The modernization effort at ITO also includes a new 64,000 square foot cargo facility that will help to streamline cargo and freight operations.

5.1 Inventory of Water Use

ITO's water distribution system was supplied by the Department of Water Supply, County of Hawaii. Water consumers at ITO (total 33 meter accounts) are served by multiple water lines, as presented in Figure 5-1.

Historical master meter data for potable water were provided from fiscal year (FY) 2013 (July 2012 to June 2013) to FY 2016 (July 2015 to June 2016) on a monthly basis, as summarized in Table 5-1. During this period the average potable water consumption at ITO was 7.5 MG/year, or 0.02 MGD. The average water cost for the same time period was approximately $60,000 per year, as presented in Table 5-2.

The historical water meter readings at ITO included cumulative monthly meter readings at each meter location and then water usage for the month was calculated by subtracting the meter reading of the previous month from the current month.

A summary of potable water usage data by meter account is provided in Table 5-3. Table 5-3 ranked all the meter locations by the highest average potable water usage for the most recent FY 2016 (July 2015 to June 2016).

The data presented in Table 5-3 indicates the largest water users at ITO are the post office facility and the terminals, which includes the cooling tower.

Legend

Potable Water

0 150 300 Feet

Figure 5-1
ITO Water Distribution System Map
Hilo International Airport
Hilo, HI

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Table 5-1. Historical Water Usage at ITO, in 1,000 gallons

Month	FY 2013 (July 2012 to June 2013)	FY 2014 (July 2013 to June 2014)	FY 2015 (July 2014 to June 2015)	FY 2016 (July 2015 to June 2016)
July	474	889	664	626
August	593	544	564	762
September	521	595	707	546
October	566	798	696	733
November	471	708	659	582
December	427	565	630	921
January	539	558	681	617
February	497	552	624	522
March	565	596	522	773
April	620	544	639	779
May	564	437	671	697
June	509	715	564	936
Total	**6,346**	**7,501**	**7,621**	**8,494**
Average	**7,490**			

Table 5-2. Historical Water Costs at ITO, in $

Month	FY 2013 (July 2012 to June 2013)	FY 2014 (July 2013 to June 2014)	FY 2015 (July 2014 to June 2015)	FY 2016 (July 2015 to June 2016)
July	$4,228	$6,068	$5,227	$5,535
August	$4,730	$4,661	$4,831	$6,167
September	$4,431	$4,873	$5,420	$5,062
October	$4,608	$5,727	$5,379	$5,696
November	$4,215	$5,345	$5,225	$5,140
December	$4,035	$4,750	$5,095	$6,377
January	$4,481	$4,725	$5,306	$5,270
February	$4,321	$4,694	$4,871	$4,913
March	$4,006	$4,879	$4,660	$5,808
April	$4,856	$4,660	$5,185	$5,831
May	$4,621	$4,226	$5,246	$5,537
June	$4,399	$5,373	$4,548	$6,310
Total	**$52,931**	**$59,981**	**$60,993**	**$67,646**
Average	**$60,388**			

Table 5-3. Summary of Water Usage at ITO, in 1,000 gallons

Rank	Account No.	Meter No.	DOT-A Name	Service Address	Jun-16	May-16	Apr-16	Mar-16	Feb-16	Jan-16	Dec-15	Nov-15	Oct-15	Sep-15	August-15	July-15	12-Month Average
1	110-49580	W0019742321	US Post Office	1099 Kekuanaoa St	163	177	160	79	94	85	116	124	214	183	332	185	159
2	110-49520	W0005064445	Terminal Restaurant	1099 Kekuanaoa St	300	157	159	253	58	167	297	115	60	60	80	77	149
3	110-49550	W0017013861	Terminal Bar Area	1099 Kekuanaoa St	163	113	152	113	131	123	138	108	134	93	142	155	130
4	110-49640	W0004227934	Overseas Terminal Arrivals	1099 Kekuanaoa St	47	57	62	51	55	53	70	37	64	49	58	18	52
5	110-49380	W0005370055	Terminal by Gate 1	1099 Kekuanaoa St	24	42	41	59	35	37	53	56	55	32	39	52	44
6	110-49490	W0005311642	Departures	1099 Kekuanaoa St	53	50	52	49	28	39	43	32	34	40	8	29	38
7	110-49710	W0060002038	ITO TBD	1505 Mokuea St 1	24	22	26	36	22	20	23	19	26	18	19	24	23
8	110-49820	W0005541816	Maintenance Base Yard	1505 Mokuea St 1	23	14	36	30	31	20	14	7	21	10	12	13	19
9	110-49390	W0009051082	Fire Pit	1099 Kekuanaoa St	40	0	0	37	0	0	89	2	51	0	1	0	18
10	110-49983	W0025775977	Street Side T-Hangar	1099 Kekuanaoa St	16	12	16	14	16	12	16	10	13	8	11	14	13
11	110-49430	W0029309697	Curbing	1099 Kekuanaoa St	9	11	23	10	10	7	6	7	18	12	20	13	12
12	110-49700	W0003338838	ITO TBD	1505 Mokuea St	11	7	11	7	11	16	17	7	13	11	16	17	12
13	110-49610	W0005064447	Terminal Next to Ag. Bldg.	1099 Kekuanaoa St	8	6	7	8	6	7	8	6	8	4	7	7	7
14	110-52200	W0082326792	ITO TBD	137 Operations Rd	10	7	9	7	7	6	7	4	6	10	1	3	6
15	110-51800	W0095017033	ITO TBD	137 Operations Rd	6	4	4	5	4	5	4	4	4	4	5	5	5
16	110-51500	W0082326649	ITO TBD	1099 Kekuanaoa St	6	4	5	4	4	3	5	5	4	4	3	4	4
17	110-49360	W0007096899	ITO TBD	1099 Kekuanaoa St	5	3	4	3	3	5	6	3	3	2	2	5	4
18	110-49470	W005419572	ITO TBD	1099 Kekuanaoa St	0	0	0	0	0	0	0	28	0	0	0	0	2
19	110-49670	W0009015636	Overseas Bus Parking	1099 Kekuanaoa St	3	3	5	4	3	6	2	1	0	0	0	1	2
20	550-08780	W0008038455	ITO TBD	1099 Kekuanaoa St	15	0	0	1	2	1	1	1	1	1	1	2	2
21	110-49706	W0000357322	ITO TBD	1505 Mokuea St	2	1	1	1	2	2	2	2	1	2	2	1	2
22	110-49460	W0031507088	Terminal United Ticket Counter	1099 Kekuanaoa St	1	0	1	1	0	2	0	1	2	1	1	1	1
23	110-49966	W0044966585	HOLD CARGO	Hilo Airport	1	6	0	0	0	0	2	1	0	0	1	0	1
24	550-03900	W0005607429	ITO TBD	1099 Kekuanaoa St	5	0	3	1	0	0	0	0	1	0	0	0	1
25	110-52600	W0028727980	Bench Mark	1099 Kekuanaoa St	0	1	1	0	0	0	0	1	0	1	0	0	0
26	110-51000	W0002021771	Old T-Hangar	Old Airport	1	0	1	0	0	0	1	0	0	1	0	0	0
27	550-08985	W0013802881	HOLD CARGO	Akahana St	0	0	0	0	0	1	1	0	0	0	0	0	0
28	110-49400	W0034245897	ITO TBD	1099 Kekuanaoa St	0	0	0	0	0	0	0	0	0	0	1	0	0
29	550-03800	W0005607428	ITO TBD	1099 Kekuanaoa St	0	0	0	0	0	0	0	1	0	0	0	0	0
				Totals	**936**	**697**	**779**	**773**	**522**	**617**	**921**	**582**	**733**	**546**	**762**	**626**	**708**

The following locations are targeted for alternative water source investigations because they are currently one of the largest water users in ITO, which include the following:

- Cooling Tower
- Passenger terminals

Locations of these primary facilities are presented in Figure 5-2. Figure 5-3 shows the locations of primary facilities included in the analysis.

5.1.1 Cooling Tower

As part of the Hawaii Airports Modernization Program, the air conditioning chiller plant and cooling system were replaced. As the cooling tower is an integral part of the Main Terminal, there is no separate meter; therefore, a definitive value cannot be assigned to the water usage. However, cooling towers in warm environments typically are a substantial user of potable water.

5.1.2 Passenger Terminals

The costs associated with retrofitting existing airport terminals with water reuse facilities is high because a separate reuse water supply network, or internal reuse plumbing network, would need to be constructed within the existing restroom terminals. This requires major demolition and reconstruction. However, there are few opportunities to use alternative water sources at ITO, and retrofitting the passenger terminals may be one of the few opportunities. Currently, the County of Hawaii Plumbing Codes do not allow dual-plumbing systems, which would be required if reuse water is used for toilet and urinal flushing. However, the County is contemplating updating their codes to comply with the 2012 Uniform Plumbing Code, which does allow dual-plumbing systems.

5.2 Inventory of Wastewater Generation

A map of the wastewater collection system at ITO is presented in Figure 5-4.

Because there is no direct metering of the wastewater discharge volume and flow as each consumer level, typically wastewater billing data is calculated based on potable water consumption. Therefore, the large water consumers are also large wastewater generators, unless the water consumed does not enter the wastewater system, such as water for irrigation.

Figure 5-2
ITO Locations of Primary Facilities
Hilo International Airport
Hilo, HI

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Legend

- Primary Facility
- Potable Water

N

0 150 300 Feet

Figure 5-3
ITO Locations of Primary Facilities - Terminal Area
Hilo International Airport
Hilo, HI

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Legend
- Force Main
- Sewer Line

N

0 150 300 Feet

Figure 5-4
ITO Wastewater Collection System
Hilo International Airport
Hilo, HI

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\\galt\Proj\HDOT\675792\MapFiles\Fig5-4_ITO_Wastewater_Collection_System.mxd 1/13/2017 AESPEJO

5.3 Potential Projects to Use Alternative Water Sources at ITO

The following is a listing of potential sources of alternative water and potential facilities that could use that water.

Table 5-4. Summary of Proposed Water Supply Alternatives at ITO

Potential Water Sources	Potential Facilities
Upgrade Onsite WWTP to produce R-1 Water	Cooling Tower
	Terminal – Dual Plumbing
County of Hawaii Hilo WWTP (R-1 Water)	Cooling Tower
	Terminal – Dual Plumbing
Rainwater Harvesting	Cooling Tower
Desalination	Potable Water/ Cooling Tower

5.4 Potential Alternative Water Sources and Users of Non-Potable Water Sources

5.4.1 Potential Alternative Water Sources

5.4.1.1 Onsite Wastewater Treatment

Currently the ITO wastewater is transported to the onsite WWTP, where it is treated and injected into intrusion wells. The WWTP could be upgraded to produce R-1 water, which could be used for the aforementioned uses on ITO.

5.4.1.2 Offsite Wastewater Treatment

The City of Hilo has its wastewater treated at the County of Hawaii Hilo WWTP near the ITO. Currently the Hilo WWTP discharges treated effluent into Puhi Bay. A polishing plant could be installed at the Hilo WWTP to improve the effluent to R-1 quality, which could be pumped to ITO. The County of Hawaii Hilo WWTP is shown in Figure 5-5.

Legend
- Force Main
- Sewer Line

N

0 500 1,000
Feet

Figure 5-5
ITO and County of Hawaii Wastewater Treatment Plants
Hilo International Airport
Hilo, HI

ch2m

\\galt\Proj\HDOT\675792\MapFiles\Fig5-5_ITO_and_County_of_HI_WWTPs.mxd 1/13/2017 AESPEJO

5.4.1.3 Rainwater Harvesting

The Hilo area receives an average of approximately 130 inches of rain per year. This monthly distribution is fairly uniform. Therefore, there are ample opportunities to collect rainwater from rooftops to serve as an alternative water source.

5.4.1.4 Desalination

The 2010 *Hawaii County Water Use and Development Plan Update* (Fukunaga & Associates, Inc., 2010) shows predominantly fresh groundwater in the ITO vicinity. This is consistent with the high distribution of fresh surface water in the area, making the requirement for brackish groundwater desalination unlikely. Seawater desalination via a beach well structure is a viable non-potable source for ITO, however it will likely be the most expensive supply alternative.

5.4.2 Potential Users of Alternative Water Sources

5.4.2.1 Cooling Tower

As previously stated, the cooling tower is generally a substantial user of potable water in warm climates. Cooling towers can use non-potable water, such as R-1, for make-up water.

5.4.2.2 Airport Terminal

As previously stated, the County of Hawaii currently does not allow recycled water to enter buildings. However, if the County of Hawaii updates its Plumbing Code to allow dual plumbing for toilet and urinal flushing, then the airport terminal could utilize R-1 water for those purposes.

5.5 Narrative Description of Alternatives

5.5.1 Overview of Alternatives

The following narratives provide an overview of the opportunities for ITO to use alternative sources of water for non-potable uses including cooling tower operation and toilet and urinal flushing. Each of the requires further investigation and optimization for proven feasibility and efficiency. A summary of the options are listed in Table 5-4.

5.5.2 Alternative 1: R-1 Production from Onsite Wastewater Treatment Plant

The onsite WWTP could be upgraded using an MBR plant. However, if R-1 water is used, then the biosolids would most likely need to be hauled or pumped to the Hilo WWTP, which may make this option expensive.

5.5.3 Alternative 2: R-1 Production from Offsite Wastewater Treatment Plant

The nearby County of Hawaii Hilo WWTP could produce R-1 water, which could be piped to the airport. There is an existing service road for the WWTP that could provide right-of-way for the potential pipeline.

5.5.4 Alternative 3: Desalination Water

The most cost effective use of desalination will be to supply the full potable demand of ITO via beach wells. The maximum month potable demand at ITO is approximately 22 gpm, which is low compared with the demands at other airports. The economy of scale associate with desalination would increase the relative cost of the desalinated water at ITO as well, reducing the viability of desalination as an option.

While other options for expanded water supply to ITO should be fully explored first, if a desalination option was still preferred, a beach well would be the preferred approach. Water would undergo RO and disinfection treatment near the well structure, followed by conveyance to an optional storage tank, and connection with the existing potable system. Chemical addition (post treatment) will also be required to make the desalinated water compatible with distribution and end use infrastructure (non-corrosive). The facility will be sized to supply the maximum month water demand of 22 gpm. Further investigation is required to determine if there is access to seawater used for cooling at a power plant. If not, then a beach well and brine outfall will be required.

5.6 Regulatory and Contractual Assessment

Table 5-5. Summary of Proposed Water Supply Alternatives at ITO

Potential Water Sources	Potential Facilities	Regulatory/Contractual Issues
Upgrade OnSite WWTP to produce R-1 Water	Cooling Tower	Currently the County of Hawaii does not allow recycled water to enter buildings
	Terminal – Dual Plumbing	
County of Hawaii Hilo WWTP (R-1 Water)	Cooling Tower	Currently the County of Hawaii does not allow recycled water to enter buildings
	Terminal – Dual Plumbing	
Rainwater Harvesting	Cooling Tower	N/A
Desalination	Potable Water/ Cooling Tower	N/A

Summary

The analysis of the existing water accounts at each of the four airports shows that alternative water sources could serve some of those water uses. A summary of the findings for each of the airports is listed below.

6.1 HNL (Honolulu Airport)

Most of the non-potable water use is currently being suppled free-of-charge by the Sumida Farms. However, other potential alternative water sources include:

1. Onsite Scalping Plant
2. Storm Water Harvesting
3. Rainwater Collection
4. Desalination

Some of the potential facilities that could use these alternative sources include:

1. Cooling Towers
2. CONRAC/Car Wash
3. Irrigation
4. Washdown

6.2 OGG (Kahului Airport)

OGG holds substantial potential to take advantage of alternative water sources. OGG's dependence on potable water combined with a semi-arid environment provides decent opportunities for using alternative water sources. These potential alternative water sources include:

1. Onsite Scalping Plant (R-1 Water)
2. Offsite Kahului WRF (R-1 Water)
3. Storm Water Harvesting
4. Rainwater Collection
5. Brackish Wells

Some of the potential facilities that could use these alternative sources include:

1. Cooling Towers
2. CONRAC Facility
3. Irrigation

6.3 KOA (Keahole-Kona Airport)

The main airport on the Island of Hawaii holds promise in using alternative water supplies because of the arid environment. However, there is a lack of alternative water sources in the area. The few potential alternative water sources include:

1. Storm Water Harvesting
2. Rainwater Collection
3. Brackish Wells

Some of the potential facilities that could use these alternative sources include:

1. Potable Water
2. Irrigation

6.4 ITO (Hilo Airport)

ITO receives more rain than the other three airports. There are several alternative water supplies; however, there are not many large water users that could take advantage of these water sources. These potential alternative water sources include:

1. Onsite WWTP (upgrade to R-1 Water)
2. Offsite County of Hawaii Hilo WWTP (upgrade to R-1 Water)
3. Storm Water Harvesting
4. Rainwater Collection
5. Brackish Wells

Some of the potential facilities that could use these alternative sources include:

1. Cooling Towers
2. Terminals

The challenge with ITO is that there are ample sources of water, but the corresponding potential water users are non-existent that are currently allowed to use R-1 water per County of Hawaii regulations.

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