August 25, 2021

MEMO TO: APT-57 File

F R O M: Shane M. Sinenci, Chair
Agriculture and Public Trust Committee

SUBJECT: **TRANSMITTAL OF INFORMATIONAL DOCUMENT RELATING TO THE WATER USE AND DEVELOPMENT PLAN FOR MAUI** (APT-57)

The attached informational document pertains to Item 57 on the Committee's agenda.

apt:ltr:057afile05:kmat

Attachment

rates. In October 2017, the project sponsors determined to discontinue the project, based on economics, project timeline and federal requirements. [73]

The Opana and Awalau surface water source located in the Ko`olau ASEA was described in the Ko`olau ASEA Report Chapter 16.5. An analysis by Ha`ikū Design & Analysis assessed the feasibility of expanding reservoir capacity and thereby the yield of the Opana/Awalau system for non-potable uses. A mass flow analysis determined the reliable yield of this source assuming several possible reservoir capacities. Because there were extended periods the analysis was based on providing "semi-reliable" yield in which the reservoir would be empty 10 percent of the time. Based on this analysis, it is not practical to provide drought period service reliability by expanding reservoir capacity. The yield of approximately 0.14 mgd is used by a partnership of agricultural users, including MDWS non-potable customers. It is recommended to continue and maintain this source as a non-potable water source.

Input from farmers in the region indicate that treated potable water is necessary to some extent due to Food and Drug Administration standards for produce. Potable water through the municipal system will still be needed.

In summary, agricultural irrigation needs Upcountry depend on reliable source that includes potable and non-potable water. A long term agreement that reflects the established IIFS and alternative ditch flows for the EMI system is required.

Strategy #7: Execute a long term source agreement for use and maintenance of the Wailoa Ditch that ensures adequate non-potable supply for the Kula Agricultural Park expansion and potable supply for projected MDWS Upcountry System needs over the planning period. Lead agencies are Maui County, MDWS and A&B Properties.

Surface Water Allocation for Municipal Needs

Issue and Background: Water provided by the MDWS Upcountry System is for municipal purposes. Current reliance on surface water for over 80 percent of freshwater supplies puts the Upcountry System at risk in extended droughts. Decreasing rainfall, whether as a result of long term droughts or climate change, has more immediate impacts on surface water flows making surface water vulnerable and generally less reliable over short-terms than groundwater. Groundwater is generally preferable to meet long-term reliable supply. Ha`ikū Aquifer has sufficient yield to supply projected growth Upcountry. However, well development in the Ha`ikū Aquifer must comply with the East Maui Consent Decree. The MDWS's efforts to initiate hydrologic studies and explore regional groundwater have been challenged. It is not certain that basal groundwater development in Ha`ikū Aquifer will be achievable. Makawao Aquifer yield cannot support the full projected need.

New source of about 6.3 mgd is needed to meet municipal needs and the Upcountry Meter Priority List. As stated earlier, the preferred option is to operate ground and surface water

[73] 10/4/17 USDA Soil & Water Conservation District letter

resources in the most economical manner during normal conditions with sufficient groundwater contingency source to supplement available surface water during droughts. This strategy is consistent with measures recommended for Upcountry by the Maui Drought Committee.[74]

MDWS relies on three surface water sources, one of which is delivered by EMI through the Wailoa Ditch, and the other two through two MDWS higher elevation aqueducts maintained by EMI that transport water to Olinda and Kula, under a contractual agreement originated under the 1973 East Maui Water Agreement and subsequent agreements.

Table 15-36 MDWS Upcountry System Surface Water Treatment Capacity

Water Treatment Facility	Elevation	Conveyance System	Production Capacity	Average Production
Olinda	4,200 feet	Upper Kula Flume	2.0 mgd	1.6 mgd
Pi`iholo	2,900 feet	Lower Kula Flume	5.0 mgd	2.5 mgd
Kamole Weir	1,120 feet	Wailoa Ditch	6.0 mgd	3.6 mgd

Recent amendments to the Interim Instream Flow Standards (IIFS) on East Maui streams result in decreased base flows in the Wailoa Ditch. Depending on future extent of droughts, the pace of increasing irrigation demand on the plantation and the utilization of brackish groundwater and other alternative sources, low flow conditions may not satisfy IIFS nor off-stream needs for periods of time that is difficult to predict. In drought conditions, both the Lower and Upper Kula systems require supplemental surface water from Kamole Weir and groundwater pumped up to 4,000 feet. Under current agreement with EMI, MDWS receives 12 mgd from the Wailoa Ditch with an option for an additional 4 mgd. During periods of low flow, MDWS will receive a minimum allotment of 8.2 mgd with HC&S also receiving 8.2 mgd, or prorated shares if less water is available. The August 2017 Proposed Decision restricted Wailoa ditch flow for off-stream uses so that less than 7 mgd would be available a few days a year. When more than 7 mgd is available under non-drought conditions, the proposed restored amount would come from EMI's share of the 16.4 mgd. Under normal flow, exceeding 16 mgd at Wailoa Ditch, and under an allocation of up to 12 mgd for MDWS, ditch flow could theoretically meet additional needed source of 6.3 mgd.

Water Treatment Facility Expansion

The June 2018 IIFS Decision allows continued diversions for the Upper Kula and Lower Kula subsystems. It is assumed that current production can continue at the Olinda WTF and the Pi`iholo WTF.

The Kamole Weir WTF, located at 1,120 feet elevation, utilizes the treatment processes of coagulation, flocculation, filtration, disinfection and pH adjustment for corrosion control. The

[74] Wilson Okamoto Corporation, County of Maui Drought Mitigation Strategies, 2012 Update.

majority of the treated water is boosted by the high service pump station to higher service elevations. The highest monthly average production over a ten year period is about 5.5 mgd. An assessment of Wailoa Ditch flow is needed to evaluate whether MDWS municipal needs, the Kula Agricultural Park and A&B/HC&S diversified agriculture plans can be met subject to recently adopted IIFS.

An agreement between A&B and MDWS is needed to allocate Wailoa Ditch water under the established IIFS. EMI provides water to MDWS under a Memorandum of Understanding (MOU). If the current terms continue, MDWS would receive 12 mgd from Wailoa Ditch with an option for an additional 4 mgd, for a total of 16 mgd. During periods of low flow, MDWS receives a minimum allotment of 8.2 mgd and HC&S receive 8.2 mgd. If less is available both receive prorated shares of the water available. Treatment of up to 12 mgd at 1,100 foot elevation would be a more cost effective resource to operate long-term compared to pumping groundwater from near sea level to 1,100 feet. Life cycle costs over 20 years for surface water treatment at Kamole Weir was estimated to $3.50 per 1,000 gallons in 2013. Groundwater pumpage increases life cycle costs by $1.64 to $5.93 per 1,000 gallons. Water from Kamole Weir can be booster pumped to supplement the Lower Kula and Upper Kula systems as needed.

Treatment of more than 6 mgd at the Kamole Weir will require expansion of the water treatment facility (WTF) and storage construction. Treatment plant expansion is conditioned upon an agreement with A&B Properties to secure long-term ditch flow allocation under alternative flow conditions. Treatment expansion is also contingent on reservoir storage.

Raw Water Storage Development

Raw water storage does not provide new source per se, but reduce the effects of low ditch flows by allowing surplus water to be stored during periods of high flows in the ditch to be used over periods where there is not sufficient flow for direct distribution. Raw water storage to supplement the reliable yields of the existing MDWS Upcountry surface water treatment systems was analyzed in the 2009 WUDP Upcountry District Final Candidate Strategies Draft Report by Ha`ikū Design & Analysis. Additional reservoir storage capacity increases the drought period reliable yield. Large new storage reservoirs require substantial up-front capital investments that yield long-term benefits in reduced system operation costs. The optimal capacity of raw water storage is a function of the amount of water and the streamflow characteristics of the stream, the capacities of the stream diversions and transmission. Ha`ikū Design & Analysis performed a detailed reservoir reliability and economic analysis for the Upper Kula, the Lower Kula and the Makawao subsystems. A mass flow analysis of historic streamflows, anticipated reductions in stream base flows and collection system and treatment plant characteristics determined contribution to system service reliability during drought and normal conditions for various assumed reservoir capacities for each Upcountry subsystem. Costs for estimated for various reservoir options and the analysis was conducted in several iterative rounds, considering integrated operation of the subsystems and other factors. Raw water storage compared to other resource strategies, such as basal well development, is more

expensive if considered over a 25-year planning period. Considered over a 50 year study period, raw water storage is more cost effective. [75]

Raw Water Storage for Pi`iholo Water Treatment Facility

The Lower Kula subsystem served by the Pi`iholo WTF is the most economical location for additional storage expansion. A major constraint the location is the environmentally sensitive area, which also limits the size of a reservoir. Although cost effective in terms of reduced electrical power consumption and operating costs, construction of a 100 – 300 MG reservoir near or east of Pi`iholo WTF is not deemed practical.[76]

Raw Water Storage for Kamole Weir Water Treatment Facility

New raw water storage at the Kamole Weir WTF was evaluated in a 2015 Preliminary Engineering Report (PER) to reduce the effects of low flows in the Wailoa Ditch. The PER is based on the assumption that up to 8 mgd per 24-hour period will be made available to MDWS, continent upon available flow in the Wailoa Ditch. The analysis determined required storage for a sustainable flow rate of 5 mgd and 8 mgd.[77] The majority of water treated at the Kamole Weir WTF is boosted to service areas at higher elevations. There is currently no storage of raw water at the WTF. The 2015 PER recommended initial construction of a 48 MG reservoir at a cost of $8.7 million, with an additional four reservoirs totaling 441 MG at a cost of about $50M.

Table 15-37 Required Reservoir Storage for Year-Round Sustainable Supplies of 5 and 8 MGD

Scenario of Take from Wailoa Ditch	5 MGD Supply	8 MGD Supply (MG)
Unrestricted	47	92
Only Flows Above 10 MGD	138	279
Only Flows Above 20 MGD	279	470
Only Flows Above 30 MGD	336	569

Source: Storage Yield Analysis by Tom Nance Water Resource Engineering, July 15, 2014

The analysis by Ha`ikū Design & Analysis showed that this option would cost less than addition of basal wells in Ha`ikū aquifer. Service life can be assumed to be much longer and operational costs comparatively low. The optimal size for new capacity at the Kamole Weir WTF was determined at 100 – 200 million gallons (MG). A 20 mgd reduction in Wailoa Ditch base flow would require 100 MG. A 30 MGD reduction in base flow would require a 200 MG reservoir.[78]

[75] Haiku Design & Analysis, Maui County Water Use and Development Plan Upcountry District Final Candidate Strategies Report, July 27, 2009

[76] Ibid.

[77] Austin, Tsutsumi & Associates, Inc. Preliminary Engineering Report for Kamole Weir Water Treatment Plant Raw Water Reservoir Draft. May 11, 2015

[78] Haiku Design & Analysis, Maui County Water Use and Development Plan Upcountry District Final Candidate Strategies Report, July 27, 2009.

Ditch flows based on the June 2018 Decision have yet to be assessed. Financing of raw water storage reservoirs may not be available as State Revolving Fund loans and needs to be identified.

In summary, reservoir and treatment plant expansion would have multiple benefits:

1. Improve reliable capacity
2. Economical water supply that minimized expensive groundwater pumping costs
3. Defer source development in Ha`ikū Aquifer in light of uncertainties related to the East Maui Consent Decree
4. Recharge regional groundwater in wet season when maximizing use of stormflow from rainfall

If financing can be secured, raw water storage construction presents an economic strategy compared to basal well development. If a string of basal wells and extensive transmission would be added to the MDWS Upcountry System during the same time frame as a reservoir, the economic benefit would be significantly diminished. Both resource strategies have long implementation timeframes and can be adjusted over time. Should development of basal source in the Makawao Aquifer produce adequate yield and quality, additional wells in Ha`ikū Aquifer ***OR*** expanded surface water storage and treatment will meet projected demand. Uncertainties in future stream flow must be weighed against increased reliability and cost of basal well development. Maximizing affordable surface water use in wet season must be weighed against "over building" expensive wells and infrastructure that is not used to capacity.

Strategy #8: Pursue hydrologic studies needed to explore the Ha`ikū Aquifer **and** an updated ditch flow analysis to optimize raw water storage and treatment plant capacity at Kamole Weir in order to expedite the most feasible new source. Raw water storage and Kamole Weir Water Treatment Facility expansion are contingent on a long-term agreement with A&B Properties allocating adequate surface water for the MDWS Upcountry System. The lead agency is MDWS.

This strategy supports multiple planning objectives, including to seek expanded municipal withdrawal from the lowest cost source to serve the Upcountry region and to increase water storage capacity with a reserve for drought periods.

It should be noted that improved storage and transmission efficiencies and limited source development have resulted in meters currently being offered to applicants on the Upcountry Meter Priority List. Although the creation of the List was due to source shortage, the pace of meter offerings is slow due to the backlog of applications, staff resources, and the complexity of processing meter offers.

15.8.4 Climate Adaptation

Issue and Background: Data and research suggest that Hawai'i should be prepared for a future with a warmer climate, diminishing rainfall, declining stream base flows, decreasing groundwater recharge and storage, and increased coastal groundwater salinity, among other impacts associated with drought. Reliance on surface water will become more uncertain in a future of longer droughts and varying rainfall. No streamflow projections are available for the

Summary of Board of Water Supply Temporary Investigative Group October 17, 2019, as Amended & Approved December 19, 2019

A Temporary Investigative Group (TIG) to explore options for ensuring access to water was approved on July 18, 2019. Board Members Norman Franco, Shay Chan Hodges, and Toni Eaton were tasked with:

> ***Exploring the Feasibility of Purchasing and Maintaining the EMI Water Delivery System and Examining Other Alternatives for Ensuring That The People of Maui County Have Authority Over the Delivery of Water, Which is A Public Trust***

The following is a summary of the report, which was made public on October 17, 2019 and approved with amendments on December 19, 2019.

The TIG Report includes background about the genesis of the investigation, descriptions of the East Maui Irrigation System (EMI), with a particular focus on the system's impacts on East Maui and Upcountry Maui. (Pages 1-16) It also includes strategies for creating and conserving Maui's fresh water capacity and historical information about native Hawaiian water rights. All of this information includes links to source documents and extensively quotes the EMI/Alexander & Baldwin Environmental Impact Statement published in September 2019 and the Water Department's Draft Water Use and Development Plan, as well as studies, historical documents, and the Hawaiian Homes Commission Act. (Pages 17-48)

Under Considerations RE: Purchasing and Maintaining EMI System (Page 49-63), the TIG report reviews:

- *East Maui H20 Roundtable;*
- *Condemnation Requirements (Per Maui County Corp Counsel);*
- *Fair Market value of the EMI System;*
- *Legal Ownership of the EMI System;*
- *Assessed Value of the EMI System Relative to Repairs Needed;*
- *Operating Costs and Management Considerations;*
- *Opportunities for Direct Cost Savings Through Improved Maintenance;*
- *Liabilities;*
- *Opportunities for Indirect Cost Savings through Mitigating Health and Safety Risks;*
- *Opportunities to Support Culturally and Community-Based Economic Development As Defined by the Community;*
- *Economic and Other Benefits of Accountability Regarding Streams Flows;*
- *Safeguarding Public Health & Community Security;*
- *Potential Sources of Public and Environmental and Infrastructural investment funds; and*
- *Risks of Leaving Access to the Public Trust in Private Hands.*

On Page 64, the *following considerations are outlined for determining the Costs and Benefits of Purchasing EMI System:*

1) Determination of legal ownership of all aspects of the EMI Water Delivery System;
2) A thorough engineering and cost analysis of the current EMI Delivery system;
3) Annual costs of maintaining the EMI System; including an assessment of liability issues;
4) Potential revenues based on domestic water and agricultural water sales;

5) Potential positive impacts of control of the revenue stream of Wailoa Ditch and/or the entire EMI system;
6) Risk of allowing a private equity firm and foreign pension fund to control a significant amount of Maui's water, which is a Public Trust, and to have outsized influence over Maui's water, agricultural industry and food security for 30 years.

From page 65-68, alternatives water sources are described. On page 69, alternatives to purchasing the EMI System, including exploration of a partnership with the current owners is described. From page 70-75, calculations for initial purchase price, estimated expenses, and potential revenues for a public trust water system are outlined. Page 76-77 describes the process of the county bidding on a long-term lease and Page 78-79 provides example governance structures. P. 80-81 outlines the primary considerations with regard to the public trust.

Recommendations:

1. ***Recommended Immediate Actions (P. 81-82)***

- County Application for a Long-Term Lease
- Re-negotiate Current Contracts with EMI/Mahi Pono

2. ***Recommended Near-Term Actions (P. 82):***

The TIG recommends that the County of Maui exercise its powers of eminent domain as soon as possible to begin the process of supporting acquisition of the system.

Additional Recommendations for Long-Term Stewardship of the Public Trust

This TIG believes that ownership of the EMI Water Delivery system by the people of Maui or a partnership – in the form that is most cost-effective, accountable, environmentally responsible, transparent, and meets the needs of the island's diverse stakeholders, in particular native Hawaiians – will ultimately be the only way to guarantee that the public trust is maintained and remains safely in community hands. The TIG therefore recommends that the County of Maui take immediate steps to secure community ownership and control of the EMI water delivery system, or a partnership.

15.1 PLANNING FRAMEWORK

15.1.1 Key Issues

Issues Raised in the Water Use and Development Plan Public Process

Initial efforts to update the 1990 WUDP included a public process and stakeholder meetings in 2007 – 2009 that addressed the MDWS Upcountry system but not all water uses and users in the Central ASEA. The Upcountry Water Advisory Committee identified a broad range of planning objectives and suggested candidate strategies for this MDWS system.

The WUDP update was reignited at the end of 2015 and MDWS staff subsequently held several rounds of open public meetings, workshops and focus meetings for various stakeholder and special interest groups during 2016 that identified key issues and concerns for each region. In addition to input at meetings, the Department conducted manual and on-line surveys to poll residents on water issues and solutions for their regions. Because the overlap between the MDWS water systems and hydrologic boundaries can be confusing, meetings held in Upcountry focused both on the resources within the Central and Ko`olau Aquifer sectors and the MDWS Upcountry system, while meetings held in Central Maui focused on the Wailuku aquifer sector and the MDWS Central System. Many of the issues raised pertain to stream diversions from the Ko`olau ASEA that are ultimately transported to Central and Upcountry Maui. While overlapping, key issues identified for the Central ASEA, which includes Central, South and Upcountry Maui communities and water resources within the Ko`olau ASEA relate to managing the development and transportation of water from areas with abundant rainfall to areas with scarce rainfall and subsidizing infrastructure in water scarce areas, maintenance of traditional resource management using the ahupua`a system and ensuring that traditional and customary practices are safe guarded. Much of the public water use in the Central ASEA relies on Ko`olau surface water resources conveyed via privately owned transmission systems. A key issue for the region is providing affordable water for future needs, providing for Upcountry and central Maui isthmus farming and other public trust uses during droughts, and managing resources in a sustainable way.

Key issues and concerns can be categorized within the following interests:

- Water Management and Transport
- Streamflow Protection and Native Hawaiian Rights and Uses
- Department of Hawaiian Homelands Needs
- Impact of HC&S transition
- Environmental Protection
- Alternative Water Sources and Conservation
- Water Availability and the Upcountry Priority List

Water Management and Transport

- Transport of water primarily from the Ko`olau ASEA to Upcountry, Central, and South Maui is an issue for all of the affected communities.
- Understanding of the concepts of "precautionary planning" to reduce and adapt to the effects of drought and climate change upon water resource availability and quality is important.
- The cost of managing the East Maui Irrigation System is necessary information to evaluate future management responsibilities.

Streamflow Protection and Native Hawaiian Rights and Uses

- Access to lands for gathering, hunting and other native Hawaiian traditional and customary practices.
- Consultation and coordination with Native Hawaiian community/moku and local experts on resource management and invasive species removal should be prioritized.
- Increase streamflows in order to facilitate an increase in cultivation of kalo.

Water Availability and the Upcountry Priority List

- Adequate water supply to support Upcountry agriculture is a community value.
- The Community Plan says if water is available the priority is agriculture and DHHL.

Alternative Water Sources and Conservation

- Adapting future populations to local water resource conditions, integrating conservation and the use of alternative resources

Environmental Protection

- Watershed protection and its prioritization is important, including invasive alien plant control, ungulate control, and reforestation via watershed partnership programs.
- Build up what is taken from aquifers.

Department of Hawaiian Homelands Needs

- Water needs of DHHL should be considered in general and in accordance with the 2017 State Water Projects Plan.

Impact of HC&S transition

- Long term plans to manage the EMI system, including use and maintenance of reservoirs are a concern
- EMI system efficiency

Waihe'e Aquifer System Area, which is hydraulically connected to the `Īao Aquifer System Area.[65]

5.6 Surface Water Availability

There are 90 perennial streams in Maui, 82 of which have been diverted to some extent (Appendix 4). Streams provide riparian and instream habitats for many unique native species, support traditional and customary Hawaiian gathering rights and taro cultivation, provide recreational and aesthetic enjoyment, and affect the physical and chemical quality of receiving waters such as estuaries, bays, and nearshore waters. [66] Water from streams supplies a small proportion of drinking water island-wide but is a significant source of supply in West Maui and Upcountry.

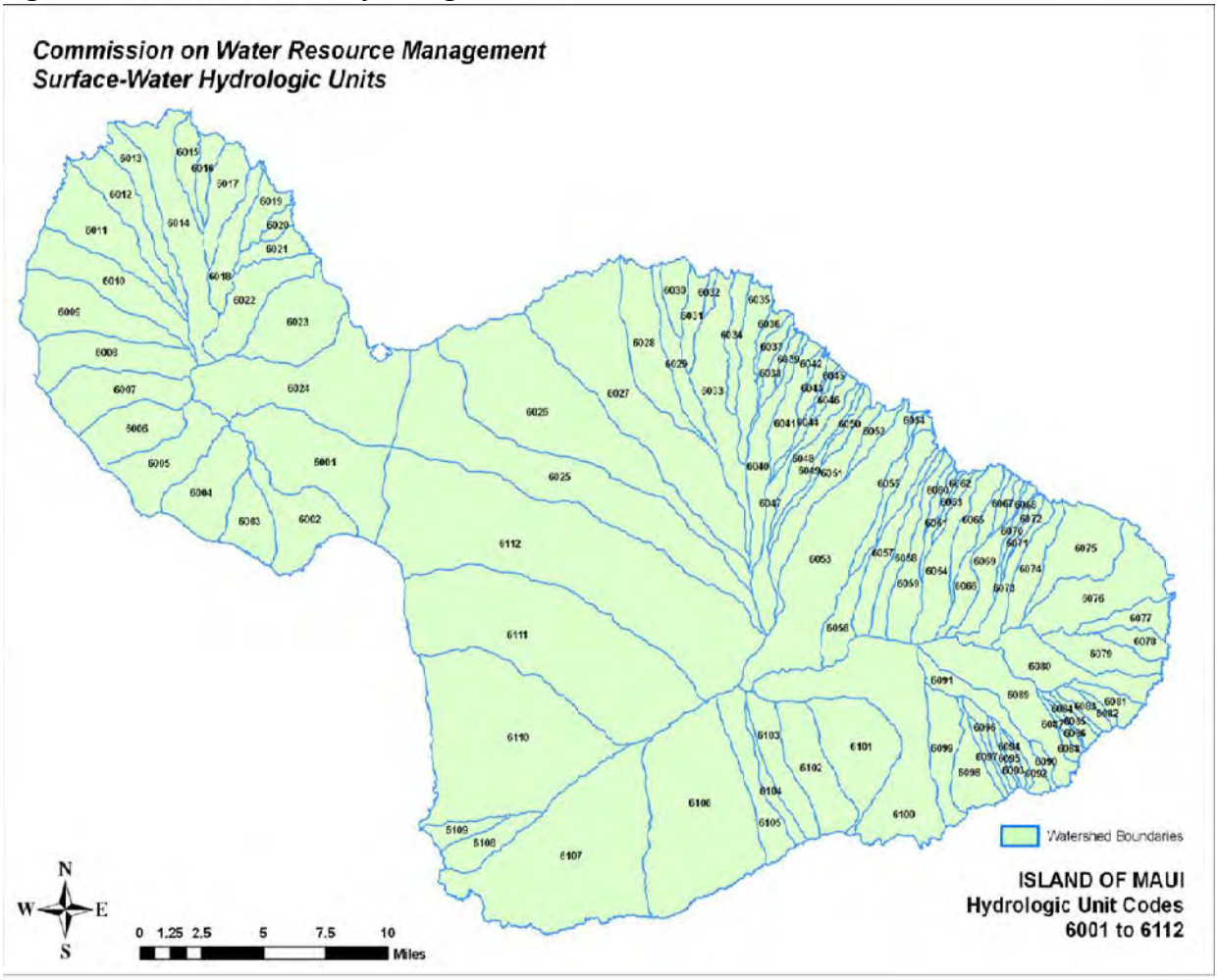
The availability of surface water is uncertain due to multiple factors such as information about surface water resources and the effects of diversions on the ecosystem, as well as lack of numerical instream flow standards and legal issues. The main issues related to surface water in Hawai`i are: (1) streamflow availability; (2) the reduction of streamflow by surface diversions and, in some areas, ground-water withdrawals; (3) floods; (4) water-quality changes caused by human activities; and (5) erosion and sediment transport. The use of surface water in Hawai`i by agricultural and municipal water users and streamflow reduction caused by diversions often conflicts with traditional Hawaiian practices (taro cultivation and gathering of stream fauna), stream ecology, water quality, recreational activities, and aesthetics.[67]

The drainage areas of surface water that are confined by topographic divides are generally referred to as watersheds. Surface water hydrologic units have been established by CWRM to provide a consistent basis for managing surface water resources. The watershed boundaries and hydrologic unit codes for Maui Island are shown in the figure below. While the WUDP is organized based on aquifer sector areas, surface water hydrologic units are referenced as relevant for watershed management, analysis of water transfers and resource use.

An inventory of streams on Maui is provided in Appendix 4.

[65] CWRM Monitoring Data, http://files.hawaii.gov/dlnr/cwrm/monitoringdata/dmw_infos.pdf, August 2, 2016.
[66] Cheng, C.L., 2016, Low-flow characteristics for streams on the Islands of Kaua'i, O'ahu, Moloka'i, Maui, and Hawai`i, State of Hawai`i: U.S. Geological Survey Scientific Investigations Report 2016-5103, 36 p. http://dx.doi.org/10.3133/sir20165103
[67] Surface Water in Hawai`i: U.S. Geological Survey Fact Sheet 045-03, Oki, D.S., 2003

Figure 5–9 Surface Water Hydrologic Units



Instream Flow Standards

In accordance with the Water Code, the CWRM establishes and administers instream flow standards on a stream-by-stream basis as necessary to protect the public interest. Instream flow standard is defined as, "a quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses."

Section 174C-3, Hawai`i Revised Statutes, defines instream use as "beneficial uses of stream water for significant purposes which are located in the stream and which are achieved by leaving the water in the stream". Instream uses include, but are not limited to:

(1) Maintenance of fish and wildlife habitats;
(2) Outdoor recreational activities;
(3) Maintenance of ecosystems such as estuaries, wetlands, and stream vegetation;
(4) Aesthetic values such as waterfalls and scenic waterways;

(5) Navigation;
(6) Instream hydropower generation;
(7) Maintenance of water quality;
(8) The conveyance of irrigation and domestic water supplies to downstream points of diversion; and
(9) The protection of traditional and customary Hawaiian rights."

The CWRM's mandate is to establish instream flow standards that will protect instream uses while allowing for reasonable and beneficial offstream use.

Interim instream flow standards (IIFS) were first adopted for both East and West Maui streams in 1988 (Sections 13-169-44 and 48, Hawai`i Administrative Rules). According to Section 13-169-46, Hawai`i Administrative Rules, "Interim Instream Flow Standard for all streams on Hawai`i, as adopted by the commission on water resource management on June 15, 1988, shall be that amount of water flowing in each stream on the effective date of this standard, and as that flow may naturally vary throughout the year and from year to year without further amounts of water being diverted offstream through new or expanded diversions, and under the stream conditions existing on the effective date of the standard, except as may be modified [by the commission]." Therefore, the IIFS established in 1988 are not based on scientific information but continue the "status quo" by setting the standard at the amount of water that was flowing in each stream on the date of adoption. For areas where measurable standards are not set, the CWRM basically regulates according to the users of surface water and groundwater which were required to register their uses with CWRM when the State Water Code was enacted. Any new diversions (unless deemed within the error of measurement) require an amendment to the IIFS. These standards will influence long-range planning instream and offstream uses.[68]

Instream flow standards need to consider the best available information in assessing the range of present or potential instream and non-instream uses. Surface water resources in an area must be quantified based on accurate long-term data before streamflow availability can be evaluated for existing and proposed uses. Balancing offstream and instream uses by the CWRM requires information on existing and future water use and quantified information on surface water availability, particularly natural flow during low-flow conditions, which has not always been available to set instream flow standards, support decision making and resolve litigation over rights to water between diverters and those desiring sufficient flow for instream uses as discussed below. The availability of streamflow during low-flow conditions is important to protect native stream animals, protect water quality and determine the total maximum daily load to characterize impaired waters, and to identify areas of groundwater discharge and assess the potential effect of groundwater withdrawal. [69]

[68] Maui Island Plan, Chapter 6 Infrastructure and Public Facilities
[69] Cheng, C.L., 2016, Low-flow characteristics for streams on the Islands of Kaua'i, O'ahu, Moloka'i, Maui, and Hawai`i, State of Hawai`i: U.S. Geological Survey Scientific Investigations Report 2016-5103, 36 p. http://dx.doi.org/10.3133/sir20165103

The annual mean "Qp" flow is the daily average flow equaled or exceeded "p" percent of the time during the year. Q_{50} is the median or natural base flow for a particular stream segment during a specified period. Base flow is dependent on groundwater discharge while total flow reflects base flow and rainfall runoff. [70] The base flow is a general guideline for the minimal amount of streamflow needed for fish habitat.[71] For perennial streams, the estimated long-term average base flow is 60 to 80 percent and thus 70 percent is used (Q_{70}). Flow exceeded 90% of time (Q_{90} flow) is commonly used to characterize low flows and flow exceeded 95 percent of the time Q_{95} represents extreme low-flow conditions.[72] The report, *Low-flow characteristics for streams on the Islands of Kaua'i, O'ahu, Moloka'i, Maui, and Hawai`i, State of Hawai`i: U.S. Geological Survey Scientific Investigations Report 2016-5103,* estimates natural streamflow under low-flow conditions using statistical models, where low-flow conditions are flow-duration discharges that are equaled or exceeded between 50 and 95 percent of the time during a 30-year base period 1984–2013. The study period is constrained by trends found in streamflow and base flow for long-term continuous-record stations; while USGS has operated many stream-gaging stations, data may be incomplete or nonexistent for some streams. The long-term downward base and low-flow trends from 1913 to 2008 reflect regional changes in climatic and land cover factors such as temperature and/or trade winds and reforestation, and decreases in groundwater storage and recharge which affect base flow.[73] The CWRM is funding the second phase of a cooperative study with USGS anticipated to be complete in 2021 to provide low flow duration discharges at existing measurement sites and develop methods to estimate selected natural low-flow duration discharges between the 50 and 90 flow-duration percentiles at ungagged sites where streamflow data is limited or unavailable on Maui and other islands using the StreamStat tool.[74]

In revising the IIFS, the CWRM defined minimum viable habitat flow (Hmin) for the maintenance of suitable instream habitat to support growth, reproduction, and recruitment of native stream animals in Nā Wai `Ehā and East Maui streams as 64% of Median Base Flow (0.64 x BFQ_{50}; also defined as H_{90} by USGS studies). For streams without measurable IFS, the IIFS generally reflects the diverted amounts existing when the status quo interim IFS were adopted, or as subsequently amended by CWRM. Low-flow conditions, or flow exceeded 90 percent of the time (Q_{90}), is therefore an appropriate starting point for considering additional offstream uses. Significant new stream diversions will require amendments to IIFS. [75] In revising the IIFS, the CWRM concluded that establishing continuous streamflow from mauka to

[70] Trends in Streamflow Characteristics at Long-Term Gaging Stations, Hawai`i. USGS SIR 2004-5080
[71] CWRM Staff Submittal, Steam Diversion Works Permit (SDWP.4175.6) Wailuku River, Maui, August 16, 2016
[72] Trends in Streamflow Characteristics at Long-Term Gaging Stations, Hawai`i. USGS SIR 2004-5080
[73] Cheng, C.L., 2016, Low-flow characteristics for streams on the Islands of Kaua'i, O'ahu, Moloka'i, Maui, and Hawai`i, State of Hawai`i: U.S. Geological Survey Scientific Investigations Report 2016-5103, 36 p. http://dx.doi.org/10.3133/sir20165103
[74] CWRM Staff Submittal regarding funding for Second Phase of Cooperative Study to Estimate Low-Flow Characteristics for Streams in Hawai`i, November 15, 2016. http://files.hawaii.gov/dlnr/cwrm/submittal/2016/sb20161115A2.pdf
[75] Cheng, C.L., 2016, Low-flow characteristics for streams on the Islands of Kaua'i, O'ahu, Moloka'i, Maui, and Hawai`i, State of Hawai`i: U.S. Geological Survey Scientific Investigations Report 2016-5103, 36 p.

makai provides the best conditions for re-establishing the ecological and biological health of the waters of Nā Wai `Ehā , and used the "Q_{90}" to establish IIFS.[76]

Instream Uses

There are essentially three areas on Maui where instream uses are at issue. The Nā Wai `Ehā contested case is within a surface water management area wherein CWRM determines the amount of water the end users are allowed to divert from the streams. The East Maui contested case addresses the instream flow standards and how much water must be left in the streams. In West Maui, CWRM is developing watershed assessments to support a determination of instream flow standards. These are summarized below.

Nā Wai `Ehā

Nā Wai `Ehā, or "the four great waters of Maui," is the collective name for the Waihe'e River and the Waiehu, `Īao, and Waikapū Streams.

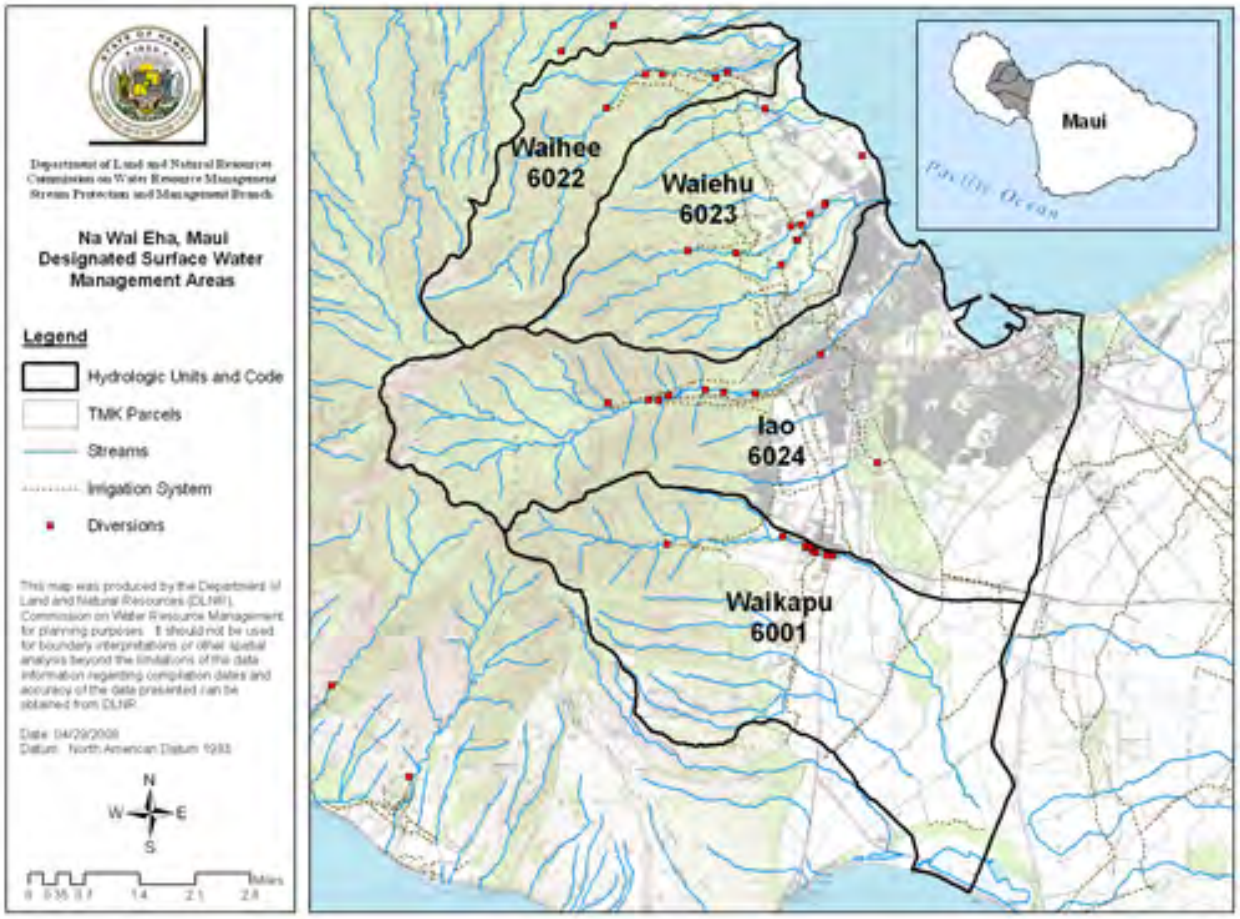
On June 25, 2004 Petitioners/Appellants Hui o Nā Wai `Ehā and Maui Tomorrow Foundation, Inc., through Earthjustice, filed a *Petition to Amend the Interim Instream Flow Standards for Waihe'e, North and South Waiehu, `Īao , and Waikapū Streams and Their Tributaries*, which had been in place since 1988. CWRM designated Nā Wai `Ehā as a surface water management area effective April 30, 2008 thereby assuming permit jurisdiction, excluding former domestic consumption of surface water by individual users, for users on any Maui Department of Water Supply water system, and for the use of rain catchment systems to gather water. A contested case addressing Instream Flow Standards (IFS), appurtenant rights and water use permits for Nā Wai `Ehā is still ongoing. The first proposed Findings of Fact (FOF), Conclusions of Law (COL), and Decision and Order (D&O) were issued by the Hearings Officer in April 2009. In June 2010, CWRM issued its FOF, COL and D&O, amending the IIFS for Waihe'e and Waiehu streams, while retaining the existing values for Wailuku River and Waikapū Stream. The decision to not amend IIFS values for Wailuku River and Waikapū Stream was appealed to the Hawai`i Supreme Court, which ruled that CWRM must consider ecosystem services, habitat for native biota, and traditional and customary practices in establishing IFS values. A mediated settlement of additional IFS values for the two streams was reached between the parties involved, which was approved by CWRM on April 17, 2014.[77] Under this agreement, more water will be returned to Nā Wai `Ehā, particularly to Wailuku River and Waikapū Stream.[78]

[76] CWRM's Findings of Fact, Conclusions of Law, and Decision and Order in the matter of the ''Īao Ground Water Management Area High-Level Source Water-Use Permit Applications and Petition to Amend Interim Instream Flow Standards of Waihe'e River and Waiehu, 'Iao, and Waikapū Streams Contested Case Hearing, June 10, 2010 (CCH-MAO6-O1).

[77] http://files.hawaii.gov/dlnr/cwrm/cch/cchma0601/CCHMA0601-2-CWRM.pdf. http://files.hawaii.gov/dlnr/cwrm/cch/cchma0601/CCHMA0601-2-CWRM.pdf.

[78] State Department of Land and Natural Resources, *Maui Parties Reach Agreement In Nā Wai `Ehā Amended Interim Instream Flow Water Case*; Press Release, April 21, 2014. http://files.Hawai`i.gov/dlnr/cwrm/news/2014/nr20140421.pdf (May 2015)

Figure 5-10 Nā Wai `Ehā -Designated Surface Water Management Areas



On December 14, 2014 the CWRM issued a *Provisional Order on Claims That Particular Parcels Have Appurtenant Rights* (CCH-MA 13-02). The third stage of the contested case process is to determine surface water use permits and the integration of the IFS, appurtenant rights and surface water use permits. However, in response to the January 6, 2016 announcement by Alexander & Baldwin, Inc. that it would close HC&S by the end of 2016 and eventually transition to diversified agriculture, on March 9, 2016 the Parties filed and on July 7, 2016 the CWRM accepted a *Petition to Amend Upward the IIFS for Waihe'e, Waiehu, `Īao, and Waikapū Streams and Their Tributaries; and Motion to Consolidate or Consider in Parallel with Case CCH-MA 15-01.*[79]

In December 2017, the contested case hearing officer issued his proposed FOF, COL and D&O. The parties have filed their objections/exceptions in January of 2018 and at the time of this Draft, CWRM has yet to adopt the proposed FOF, COL and D&O.

[79] Staff Submittal to the CWRM, June 17, 2016.
http://files.hawaii.gov/dlnr/cwrm/submittal/2016/sb20160617C3.pdf

East Maui Streams

On May 24, 2001, the Native Hawaiian Legal Corporation (NHLC), on behalf of Na Moku ʻAupuni o Koʻolau Hui (Na Moku), petitioned the CWRM to amend the Interim Instream Flow Standards (IIFS) for 27 East Maui streams. In 2008 and 2010, the CWRM approved amendments to the IIFS for about half the streams and establishing measurable IIFS of status quo conditions for the remaining streams; only six of the twenty-seven streams had flow restored. In June 2010, the County DWS and the NHLC, on behalf of Na Moku, filed petitions for a contested case hearing before the CWRM. On November 17, 2010, Na Moku appealed the CWRM's decision contending that the CWRM erred in concluding that Na Moku had no right to contest the case hearing and in reaching its underlying decision regarding IIFS amendment for the nineteen streams. On November 30, 2012, the Intermediate Court of Appeals remanded to the CWRM and the contested case hearing began on March 3, 2015. The interest asserted by Na Moku was the right to sufficient streamflow to support the exercise of their traditional and customary Native Hawaiian rights to grow kalo and gather in, among, and around east Maui streams and estuaries and the exercise of other rights for religious, cultural, and subsistence purposes. The petition also alleges that the Commission had not carried out its obligations under public trust by failing to require HC&S and EMI to prove: 1) Their actual need; 2) that there are no feasible alternative sources of water to accommodate that need; and 3) the amount of water diverted to accommodate such need does not harm a public trust purpose or any potential harm does not rise to a level that would preclude a finding that the requested use is nevertheless reasonably-beneficial.

Subsequent to HC&S announcing cessation of sugarcane cultivation by the end of 2016, CWRM ordered re-opened hearings to address HC&S current and future use of surface water and the impact on the groundwater; the impact on MDWS's use of surface water due to cessation of sugar operations; the County's position on future use of sugarcane fields, and issues concerning management of the EMI ditch system. In the September Minute Order No. 21, the CWRM hearings officer reiterated the requirement that CWRM weigh competing instream and offstream uses, including economic impact on offstream uses, in amending the IIFS.

CWMR issued their decision on June 20, 2018 for East Maui Streams (see Chapter 15, Appendix 15A) and as of this WUDP Draft no appeals were filed.

A&B, Inc. and EMI currently hold revocable permits to take water from four license areas in East Maui. In December 2016 the Board of Land and Natural Resources approved holdover of four revocable permits on a month-to-month basis through December 31, 2017 with amendments capping A&B's extraction of East Maui water at 80 million gallons per day, and ordered full restoration of seven East Maui streams used for taro farming. The Board added Honomanu Stream to the list of streams to be restored. The Board of Land and Natural Resources denied a contested case for A&B water leases in December 2018, allowing continued diversions at the time of this WUDP Draft.

West Maui

In August 2006 Maui Land & Pineapple Company (MLP) petitioned CWRM to establish amended instream flow standards for Honokōhau and Honolua Streams. In November 2008 the CWRM notified MLP that petitions would be delayed due to Nā Wai `Ehā contested case. In June 2011 the CWRM entered into an agreement with USGS to conduct a low-flow stream study for 10 streams in West Maui resulting in the report, *Low-Flow Characteristics of Streams in the Lahaina District, West Maui, Hawai`i: Scientific Investigation Report 2014–5087*. The CWRM is currently preparing instream flow assessments. In 2018, Interim Instream Flow Standards were proposed for the following streams: Ukumehame, Launiupoko, Olowalu, Kau`ula, Kahoma and Kahana streams. Stream assessments and proposed IIFS for all West Maui streams were underway at the time for this WUDP Draft.

rights are exercised in the streams in the form of subsistence gathering of native fish, mollusks, and crustaceans, and stream flows are diverted for the cultivation of wetland taro, other agricultural uses, and domestic uses that can be traced back to the Māhele. The maintenance of fish and wildlife habitats to enable gathering of stream animals and increased flows to enable the exercise of appurtenant rights constitute the instream exercise of "traditional and customary" Hawaiian rights.[84]

6.2 Historical "Big Ag" Water Use

Large-scale agriculture, primarily sugarcane and pineapple, drove Maui's economy for over 90 years, with long-lasting impacts on the island's people, land, and water. Due to the 1876 signing of the Hawaiian Reciprocity Treaty allowing duty free admission of Hawaiian sugar to the mainland United States, sugarcane cultivation expanded from 5,080 acres in 1867 to 12,000 in 1880. The pineapple industry began on Maui in 1890 and expanded steadily to cover 28 percent of Maui's cultivated lands by 1930. After World War II, improved economic conditions and increased demand for housing resulted in marginal agricultural lands being converted into urban subdivisions.[85] Within the past two decades, Maui's pineapple has all but disappeared and has been replaced with seed and diversified crops or other land uses. In 2016 A&B Properties announced that HC&S would halt sugar production at the end of the year, expressing its commitment to future agricultural pursuits on a portion of the lands used for sugarcane production as discussed in section 9.3.

Plantation Irrigation Systems

A key factor to the boom of sugarcane and pineapple was the development of extensive surface water distribution systems in West and East Maui which diverted large quantities of surface water from perennial streams into transmission ditches and tunnels, moving water from the windward side of the islands to the leeward plains. Construction of the East Maui Irrigation (EMI) ditch system was started in 1898, immediately after Alexander & Baldwin acquired HC&S. EMI's water collection system begins in the Ko`olau range in Hāna and has a capacity of 450 mgd. The water source is primarily surface water runoff from streams in a 56,000 acre watershed area. EMI, which is owned by A&B Properties, currently leases 33,000 acres of watershed area from the State of Hawai`i. The ditch system in Nā Wai `Ehā consisted of two major ditches – Waihe'e and Spreckels ditches – and nine smaller ditches used by Wailuku Water Company (former Wailuku Sugar Company) and HC&S since the late 1800s. The total capacity of the major ditches of Nā Wai `Ehā is 100 mgd encompassing a 13,500 acre watershed area. The historical ditch systems are shown below.[86]

[84] CWRM East Maui Streams Hearing Officer's Recommended FOF, COL, and D&O, January 15, 2016. Contested Case No. CCH-MA 13-01 http://files.hawaii.gov/dlnr/cwrm/cch/cchma1301/CCHMA1301-20160115-HO-D&O.pdf

[85] Maui Island Plan, State Agricultural Water Use and Development Plan, 2004

[86] State Agricultural Water Use and Development Plan, 2004

Table 6-1 Historical Ditch Systems on Maui (mgd)

Plantation and Ditches	Date	Ave. Flow *	Capacity
East Maui Irrigation Co.		**160****	**440**
(Old) Hamakua Ditch	1878		
(Old) Ha`ikū (Spreckels) Ditch	1879	(4)	
Lowrie Ditch (Lowrie Canal)	1900	(37)	60
New Hamakua Ditch	1904	(84)	
Ko`olau Ditch	1905	(116)	85
New Ha`ikū Ditch	1914	25	100
Kauhikoa Ditch	1915	(22)	110
Wailoa Ditch	1923	(170)	160-195
Wailuku Sugar Co.		**30****	
Waihe'e (Spreckels) Ditch	1882	10-2	20
Waihe'e (Ditch) Canal	1907	27	
Nine other smaller ditches			
Honolua Ranch & Pioneer Mill Co.		**50****	
Honokōhau Ditch	1904	20	35
Honolua (Honokōhau) Ditch	1913	30-18	50-70
Honokōwai Ditch	1918	6	50
Kahoma Ditch		3	
Kanaha Ditch		3.8	
Kauaula Ditch		4.5	25.5
Launiupoko Ditch		0.8	
Olowalu Ditch		4	11
Ukumehame Ditch		3	15

AWUDP, 2004, Table 1, Modified after Wilcox, Carol, 1977.

* Average flows are based on the historical record except for those in parentheses, which are from USGS records.

**Estimated average total surface water diverted.

Agricultural Challenges

Prior to its planned demise in 2016, sugarcane cultivation in Central Maui has faced many challenges, including 1) court and regulatory rulings affecting continued access to surface water from East Maui watersheds through the EMI and the West Maui ditch systems; 2) lack of reliable and economically viable markets; and 3) inadequate labor supply. Irrigation demand for sugarcane crops averaged approximately around 160 mgd over the past decade.[87] Persistent droughts and low rainfall periods have adversely affected perennial streamflows and depleted high-level groundwater aquifers that supply Hawai`i's irrigation systems. A 2001 petition to amend the interim instream flow standard for 27 streams in East Maui and restore streamflow, along with the designation of Na Wai 'Ehā as a surface water management area in 2008, rendered the future use of surface water for large scale agriculture uncertain. However, House Bill 2501 enacted in June 2016, authorizes EMI to continue diversions by holdover lease until the pending application for the disposition of water rights if resolved, or no longer than three years, whichever occurs sooner.

[87] HC&S used about 30 mgd (WWC) and 126 mgd (EMI) per Nā Wai `Ehā and East Maui Streams Contested Cases.

Between 1980 and 2015, in the State of Hawai`i pasture land decreased by 31% from 1.1 million acres to 761,430 acres, and active agricultural cropland decreased by 57% from 350,830 acres to 151,830 acres. It is highly unlikely that that crop production will ever rebound to the 1980 level, although certain crops such as commercial forestry and seed crops have increased since 1980.[88] Still, according to the 2015 State of Hawai`i Data Book, Foreign Agricultural Exports on a per-farm-receipts-basis grew from $151.5 million in 2000 to $400.4 million in 2014. Although interest in food security, organic produce, farm-to-table dining, and community farmers markets is growing dramatically, Hawai`i's agricultural industry is dominated by export markets.

The agricultural lands in Central O`ahu have become a center for local food production serving both O'ahu and the neighboring islands, as well as providing a model for locally sourced products. Although opportunities may still exist for local exports to O'ahu, Maui and other islands are challenged by the efficiency of O`ahu's larger operations and greater transportation costs than borne by O`ahu's farmers. On Maui, many small farmers need to sell directly to consumers or capitalize on restaurant and resort markets in order to secure a sufficient profit margin. High land values in productive farm areas like Kula along with gentrification are resulting in decreasing farming activities.[89] Cultivating a continuing and new generation of farmers and labor force is an underlying problem, with first and second generation immigrant farmers generally acknowledged to be the cornerstone of virtually every crop Hawai`i produces.[90]

On Maui, agriculture consumed about 90 percent of total water use in 2014 and despite the projected decline in production with the close of HC&S is expected to remain a major user. Adequate quantity and low cost water supplies to meet agricultural demand are essential to support the agricultural industry. Maui's water supplies are becoming increasingly constrained due to changes in weather patterns and climate with increasing temperatures, decreasing rainfall and less predictability; population and economic growth; state and county laws, guidelines and their interpretation; stringent application of dam and safety regulations, increased federal farm food safety requirements and regulations requiring potable water to process vegetables; and legal rulings to protect water resources, comply with water rights and the public trust doctrine, and reduce water diversions from streams for both environmental and native cultural purposes (e.g., taro farming). Further, aging infrastructure and new water sources and technologies, such as more pipelines, groundwater wells, recycled water facilities and desalination of brackish sources, are constrained by the availability of capital. Many plantation irrigation systems across the state, including the Maui Land and Pineapple/Pioneer Mill Irrigation System (MLP/PMIS) in West Maui, have been partially abandoned and are deteriorating and rehabilitation will be extremely costly. The future of the EMI system also has many pending unresolved issues as sugarcane transitions to other crops or uses. Some small agricultural and kuleana users also use these systems for conveyance. These systems will

[88] Melrose, J., Perroy, R., and Cares, Sylvana, 2015. Statewide Agricultural Land Use Baseline 2015, HDOA, page 4.
[89] Ibid, pages 5-6.
[90] Ibid, page 6.

require strategic reinvestment, subsidies, and incentives in order to support existing and new farm growth.

Hawai`i Statewide Agricultural Land Use Baseline

The 2015 Hawai`i Statewide Agricultural Land Use Baseline provides a snapshot of contemporary commercial agricultural land use activity based on geospatial and other datasets verified by multiple means. It represents the best efforts to capture the scale and diversity of commercial agricultural activity in Hawai`i in 2015 and should be used for informational purposes only. Not all properties were mapped due to the small scale of some operations.

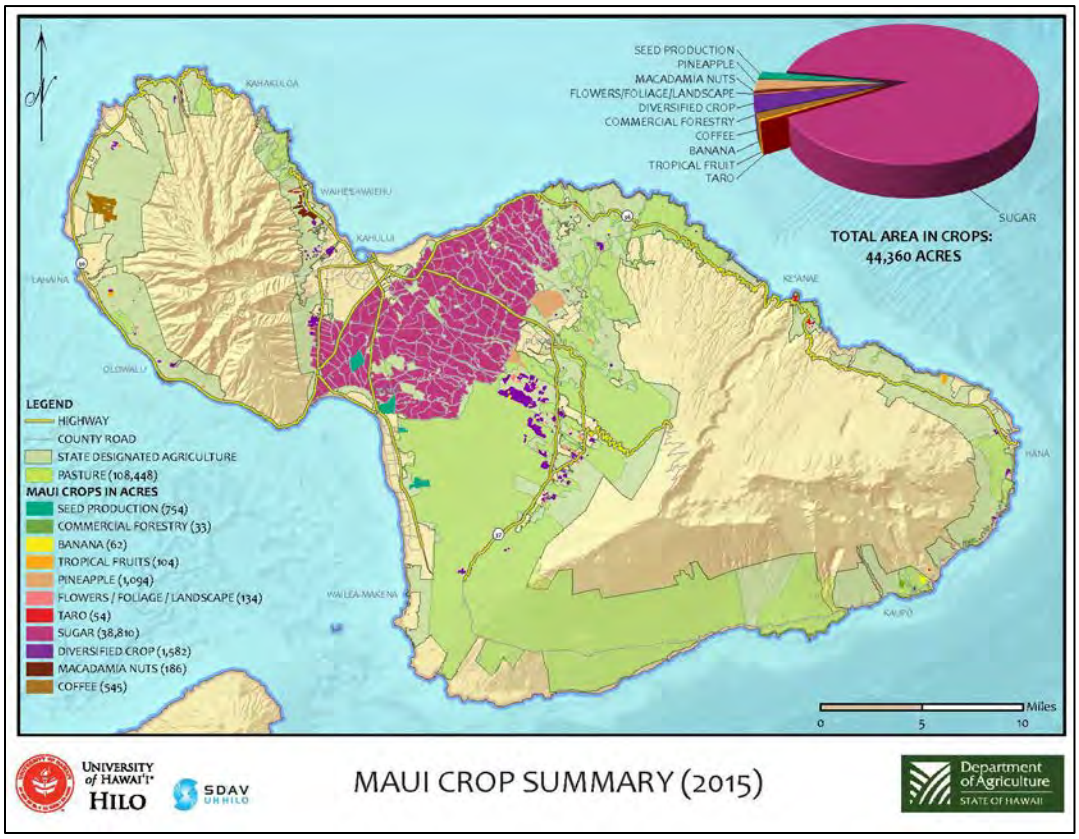
Table 6-2 Agricultural Crops and Acreage on Maui and Average Water Use Rates

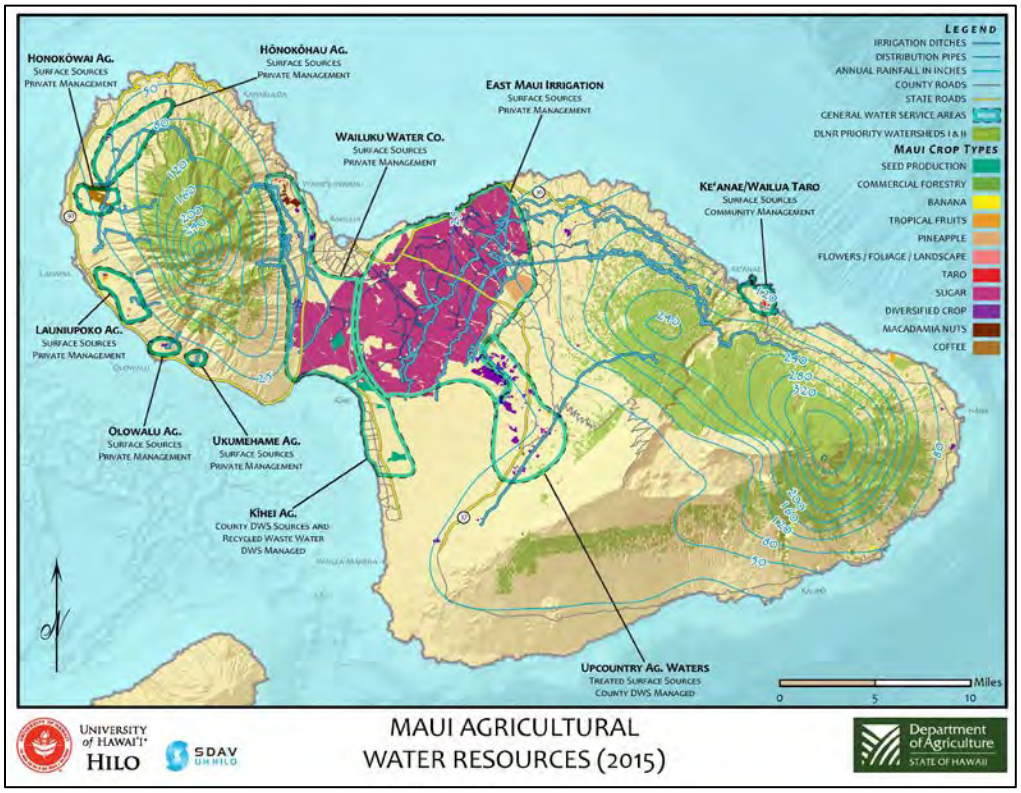
Crop	Acreage (2015)	Water Use Rate (gpd per acre)
Banana	62.38	
Coffee	545.35	2,900
Commercial Forestry	33.16	4,380
Diversified Crop	1,582.49	3,400 (2,500 wetter areas)
Flowers/Foliage/Landscape	134.28	4000 – 6000
Macadamia Nuts	186.33	4,400
Pasture	1,093.52	0 – 6700
Pineapple	1,093.52	1,350
Seed Production	754.41	6,700
Sugar	38,810.11	5,556
Taro	54.40	5,400 dryland 15,000-40,000 wetland (consumption)
Tropical Fruits	103.89	4,400 – 10,000
Total	**44,453.84**	

Water Use Rates - HDOA Guidelines; Coffee: 2004 AWUDP Kauai Irrigation System – 2,500 gpd; 2,900 gpd reported by plantation on O'ahu per Brian Kau, HDOA, personal communication 10/12/2016; Wetland taro: CWRM CC D&O, Nā Wai `Ehā and East Maui Streams, sugarcane: HC&S.

The 2015 Maui Crop Summary is shown in the figure below; small acreage operations such as taro production are difficult to see at this scale. The subsequent figure shows the location and sources of agricultural water resources.

Figure 6–5 Maui Crop Summary (2015) and Figure 6–6 Maui Agricultural Water Resources





Melrose, J., Perroy, R., and Cares, Sylvana, 2015. Statewide Agricultural Land Use Baseline 2015: HDOA, page 51.

APPENDIX 16A East Maui Streams Assessment
Based on June 20, 2018 Findings of Facts, Conclusion of Law, and Decision & Order

Unit	Unit Name	BFQ50 at IIFS (cfs)	BFQ50 at IIFS (mgd)	IIFS (cfs)	IIFS (mgd)	BF Avail. to divert at Q50	BF Avail. to divert at Q90	TFQ50 (cfs)	TFQ50 (mgd)
6027	Maliko								
6028	Kuiaha								
6029	Kaupakulua								
6030	Manawaiiao								
6031	Uaoa								
6032	Keali`i								
6033	Kakipi								
6034	Honopou	6.50	4.20	0.00		0.00	0.00		
6035	Ho`olawa								
6036	Waipio								
6037	Hanehoi	2.54	1.64	0.00	0.00	0.00	0.00		
	Puolua (Huelo) Stream	1.47	0.95	0.00	0.00	0.00	0.00		
6038	Hoalua								
6039	Hanawana								
6040	Kailua								
6041	Naili'ilihaele								
6042	Puehu								
6043	O`opuola								
6044	Ka`aiea								
6045	Punalu`u								
6046	Kolea								
	Alo								
	Wahinepe`e	0.90	0.58	0.90	0.58				
6048	Puohokamoa	8.40	5.43	1.10	0.71	4.72	-0.59	13.00	8.40
6049	Haipuaena	4.90	3.17	1.36	0.88	2.29	-0.88	6.60	4.27
6050	Punalau	4.50	2.91	2.90	1.87	1.03		3.60	2.33
6051	Honomanū	4.20	2.71	4.20	2.71	3.17	0.71	6.20	4.01
6052	Nua'ailua	0.28	0.18	2.20	1.42	-1.24	-1.42	0.56	0.36
6053	Pi`ina`au	14.00	9.05	0.00	0.00	0.00	0.00	21.00	13.57
	Palauhulu Stream	11.00	7.11	0.00	0.00	0.00	0.00	6.10	3.94
6054	Ohia	4.70	3.04	0.00	0.00	3.04			0.00
6055	Waiokamilo	3.90	2.52	0.00	0.00	0.00	0.00	7.00	4.52
6056	Wailuanui	6.10	3.94	0.00	0.00	0.00	0.00		0.00
6057	West Wailuaiki	6.00	3.88	0.00	0.00	0.00		8.50	5.49
6047	Waikamoi	6.70	4.33	3.80	2.46	1.87	-2.44	6.60	4.27

Unit	Unit Name	BFQ50 at IIFS (cfs)	BFQ50 at IIFS (mgd)	IIFS (cfs)	IIFS (mgd)	BF Avail. to divert at Q50	BF Avail. to divert at Q90	TFQ50 (cfs)	TFQ50 (mgd)
6058	East Wailuaiki	5.80	3.75	3.70	2.39	1.36	-0.58	8.00	5.17
6059	Kopiliula	5.00	3.23	3.20	2.07	1.16	-0.52	8.00	5.17
	Puaka`a Stream	1.10	0.71	0.20	0.13	0.58	-0.13	1.90	1.23
6060	Waiohue	5.00	3.23	0.00	0.00	0.00	0.00	6.20	4.01
6061	Pa`akea	0.90	0.58	0.18	0.12	0.47	-0.12	1.50	0.97
6062	Waia`aka	0.77	0.50	0.77	0.50	0.00	-0.15		0.00
6063	Kapaula	2.80	1.81	0.56	0.36	1.45	1.12	4.90	3.17
6064	Hanawi	4.60	2.97	0.92	0.59	2.38	1.08	7.70	4.98
6065	Makapipi	1.30	0.84	0.00	0.00	0.00	0.00	7.40	4.78
Wailoa Ditch Available to Divert			73.26		16.80	20.35	2.21	62.36	40.30
Petitioned Streams								124.76	80.63
Fully Restored TFQ50								70.31	45.44
IIFS					13.50				
Wailoa Ditch Flow at Honopou 2011 -15 TFQ50								135.26	87.42
New Hamakua Ditch at Honopou 2011 -15 TFQ50								19.34	12.50
Lowrie Ditch at Honopou 2011 -15 TFQ50								16.85	10.89
Ha`iku Ditch at Honopou 2011 -15 TFQ50								6.46	4.18
Ditch gain between Honopou and Maliko								13.30	8.60
Total Flow diverted prior to IIFS								191.21	123.58
IIFS Restored Streams TFQ50								70.31	**45.44**
Remains to Divert:								120.90	**78.14**
DWS Kamole Weir Average 2014									3.60
Kula Ag Park								2.50	1.62
Remains for HC&S (Est.)									**72.92**
Restoration Status Full									
Restoration Status Connectivity									

Strategy #2: Support and promote community grassroots initiatives to collaborate with state and land owner partnerships to increase participation in natural resource management and to ensure adequate access and opportunities for traditional uses of the region's natural resources. Use established moku process to consult on resource management.

16.8.2 Conservation

Encouraging water conservation and maximizing the efficiency of water use are objectives identified in the WUDP public process as well as the 1994 Hāna Community Plan.

The Pā`ia-Ha`ikū Community plan goals and objectives call for improvement of the existing potable water distribution system and development of new potable water sources prior to further expansion of the State Urban District boundary or major subdivision of land in the State Agricultural or Rural Districts.

Community Plans, public meetings and workshops helped develop qualitative criteria to evaluate and measure resource strategies against this planning objective include:

- Per capita water use decreased.
- Potable and irrigation systems water loss decreased.
- Community water education increased.
- Incentives for water conservation increased.
- Renewable energy use increased.

Issue and Background: The recommended supply and demand side conservation strategies outlined in Section 12.2 apply island wide. Demand side public education and outreach benefit all water systems and end uses. Billed consumption in the MDWS Ha`ikū area is low compared to other MDWS water systems or districts. Considering abundant rainfall and associated low irrigation needs this is consistent with empirical data in similar wet regions. The average water consumption per single-family meter is 425 gallons per day, which is well below the County-wide system standard of 600 gpd per single-family unit.

16.8.3 Conventional Water Source Strategies

Conventional water sources include groundwater (wells and tunnels) and surface water (stream diversions). Region specific planning objectives related to ground and surface water use and development identified and confirmed in the WUDP update public process include:

- Improving the understanding of the concepts of "precautionary planning" to reduce and adapt to the effects of drought and climate change upon water resource availability and quality.

- Adapting future populations to local water resource conditions, integrating conservation and the use of alternative resources.
- Water needs of DHHL in the Ko`olau should be considered in general and in accordance with the 2017 State Water Projects Plan.

Planning objectives related to groundwater and surface water source use and development identified to apply island wide include:

- Manage water equitably.
- Provide for Department of Hawaiian Homelands needs.
- Provide for agricultural needs.
- Protect cultural resources.
- Provide adequate volume of water supply.
- Maximize reliability of water service.
- Minimize cost of water supply.
- Increase water storage capacity with a reserve for drought periods.
- Ensure that adequate water capacity is available for domestic needs of the region.
- Ensure that the development of new water sources does not adversely affect in-stream flows.
- Improve the existing potable water distribution system and develop new potable water sources prior to further expansion of the State Urban District boundary or major subdivision of land in the State Agricultural or Rural Districts.
- Ensure adequate supply of groundwater to residents of the region before water is transported to other regions of the island.

Qualitative criteria to evaluate and measure resource strategies against these planning objectives include:

- Public water system water shortages to serve existing customers avoided.
- Public water supply drought shortages avoided.
- MDWS prioritize DHHL needs over lower priority needs.
- Potable water use for non-potable needs decreased.
- Contingencies in place to support water supply system functions during emergency conditions.
- Water is available to serve Maui Island Plan development.
- Strategies to meet all needs incorporated into WUDP.

Potable Groundwater Development

Issue and Background: The Maui Island Plan addressed the MDWS System need, excluding private purveyors, irrigation and agricultural demand. The MDWS Ha`ikū Sub-System is served

by groundwater wells in the Ha`ikū Aquifer. The following objectives derived from the Maui Island Plan should guide groundwater development in the region:

- Provide adequate volume of water to timely serve planned growth in MIP.
- Increase capacity of water systems in striving to meet the needs and balance the island's water needs.
- More comprehensive approach to water resource planning to effectively protect, recharge and manage water resources.
- Ensure stable chloride levels in developed wells.

The amount of groundwater that can be developed is limited by the amount of natural recharge and aquifer outflow that contribute to streamflow and to prevent seawater intrusion, established as Sustainable Yield. Because delineation of aquifer sectors and systems in some cases are based on limited hydrologic information, areas for potential groundwater development must be assessed on its own merits to determine any additional needs for hydrologic studies and interaction with surface water and other sources.

Understanding potential impact of climate change adds to uncertainty in long-term groundwater availability. The primary responsibility to determine potential impacts on water resource availability lies with the State CWRM who in turn relies on studies and predictions by the scientific community and other agencies. Water purveyors need guidance on how to mitigate and adjust to potential changes in groundwater availability.

Potential effects of groundwater development on streamflow and on the quality of water pumped from existing wells in a region can be evaluated by robust hydrologic studies and models. Joint funding and collaboration between the municipal and private purveyors, CWRM and the U.S. Geological Survey would focus studies to maximize benefits and prevent conflicts in water development and designation. Aquifer systems in Ko`olau are not extensively studied, as indicated by CWRM's confidence rating in establishing Sustainable Yield. Ha`ikū Aquifer has sufficient yield to serve regional demand and support development of planned growth areas outside Ko`olau. It is recommended that CWRM prioritize hydrological studies and groundwater modeling in Ha`ikū and Honopou regions to guide private and public well development and ensure potential impacts on surface water is addressed first.

Strategy #3: Support collaborative hydrogeological studies to inform impact from climate change and future well development on groundwater health for Ha`ikū and Honopou Aquifers.

Honopou is not serviced by public water supply. Limited growth is assumed to continue depend on domestic wells, rainfall catchment systems and surface water for irrigation needs. Ha`ikū Aquifer is the main source for municipal water supply in Ha`ikū. A fraction of the Sustainable Yield has been developed. Regional basal groundwater can continue to provide for municipal, domestic and irrigation needs, even under drought conditions and a potential high-growth scenario.

Installed pump capacity for private and public water systems in Ha`ikū Aquifer System totals 12.58 mgd, if pumping 24 hours per day. To account for system standards, pumping 16 hours, installed system capacity can provide about 8.39 mgd, shown below as "Estimated Available Capacity."

Table 16-37 Groundwater Source Development to Meet Population Growth-Based Demand in Ha`ikū Aquifer System 2035 (mgd)

Aquifer System	Installed Source Capacity	Estimated Available Capacity (16 hours pumpage)	2035 Projected Demand	Sustainable Yield (MGD)	Potential Drought Yield Conditions
Ha`ikū	12.58	8.39	0.878	27	19.26

Source: MDWS Water Resources & Planning Division, 2018.

Basal well development to meet out of region demand is addressed in the Central Aquifer Sector report Chapter 15.8.3. Groundwater development by MDWS in Ha`ikū Aquifer is also subject to a consent decree that restricts well development from a specified portion of the aquifer.

Department of Hawaiian Homelands Build-Out

Issue and Background:

Water service to most existing DHHL development and facilities on Maui is currently provided by the County MDWS systems. There are no DHHL owned and operated water systems on Maui. The 2017 SWPP DHHL Update projects a potable water demand of 3,400 gpd (Ke`anae Tract) which is presently provided by the MDWS, and 6,868,000 gpd of non-potable water: (1) Ke`anae = 312,800 gpd of ambient rainfall irrigation and 4,275,000 gpd of stream diversion; and (2) Wailua = 2,280,200 gpd (180,200 gpd ambient rainfall irrigation + 2,100,000 gpd stream diversion). The DHHL plans to develop its small Ke`anae tract (150.9 acres) with Subsistence Agricultural homesteads and General Agriculture and lo`i kalo uses.[119] The two-acre makai property is within the flood zone, which prohibits homesteading use; therefore, the property will be developed for community use because of its oceanfront location, which presents opportunities for a gathering area and for cultural practices.[120] The Wailua tract (Alternative 1 option) was selected in the 2004 DHHL Maui Island Plan, which proposes 28 acres of Subsistence Agricultural use, 52 acres of General Agriculture use, and 10 acres of Conservation. The Wailua Project Alternative 2 option experienced local community opposition due to the fact that the people already living in Wailua felt that they should have been given land grant priority over those from elsewhere on the DHHL waiting list, and that DHHL "outsiders" (from

[119] State Water Projects Plan, Advance Report, 2016, Page xvi.
[120] State of Hawai`i, DHHL Maui Island Plan, 2004, page 6-22.

Wailua) may not be compatible with the area; therefore, concerns arose that the cultural and life ways balance within the Wailua community could be compromised. The projections in the tables below do not take into account alternate sources of water that may be available or developed. Therefore, the values in these tables should not be used to compare project water demands and available source water. The 2004 DHHL Island Plan states that catchment systems could be used for both consumption and irrigation.[121][4] However, the MDWS Water System also has the capacity to serve these lands.[122][5] A six-inch waterline from the highway would be required.[123]

Table 16-38 DHHL Full Build-Out Water Demand Projections by CWRM Use Type, Ko`olau ASEA

DHHL Land Use Category Based			
DHHL Land Use	**Acres / Res Units**	**Water Use Rate (gpd)**	**Projected Demand (gpd)**
Residential *	43*	600 gal/unit	25,800
Commercial	0	3,000 gal/acre	0
Industrial	0	6,000 gal/acre	0
Agriculture **	230 **	3,400 gal/acre	782,000
Open Space	10	0	0
Community	2	1,700 gal/acre	3,400
Military	0	0	0
Total	**43 Units/242 acres)**		**811,200**

Source: MDWS Water Resources & Planning Division. Figures may not add due to rounding. Open Space, Conservation/Cultural Protection and similar land use types not included due to lack of water demand.
County Zoning: Based on zoning supplied by Maui County Planning Department, Long Range Planning Division, May 2015. DHHL lands are excluded.
*Residential use is based on 32 3-acre Subsistence lots in Ke`anae (32 lots x 600 gpd = 19,200 gpd) and nine 3-acre lots in Wailua (9 lots x 600 gpd = 5,400).
**The DHHL agricultural water use estimate (106 x 3,400 gpd = 360,400 gpd) is derived from 124 Subsistence Agricultural acres (41 3-acre units [32 in Ke`anae, 11 in Wailua]) subtracted out due to a potable demand of 600 gpd being allocated to residential use and DHHL plans to use catchment for irrigation.

[121] State of Hawai`i, DHHL Maui Island Plan, 2004, page 6-22.
[122] Ibid.
[123] Ibid, page 6-32.

Surface Water Use and Development

Issue and Background: Mauka to makai streamflow is at the core of the traditional and self-sufficient Native Hawaiian livelihood of communities in Ko`olau. Surface water is diverted for a variety of purposes. The community has raised concerns over sufficient streamflow to support taro (lo`i kalo), droughts and climate change impacts, potential new diversions and compliance with the Public Trust Doctrine.

Reliance on Regional Resources vs. Water Transports

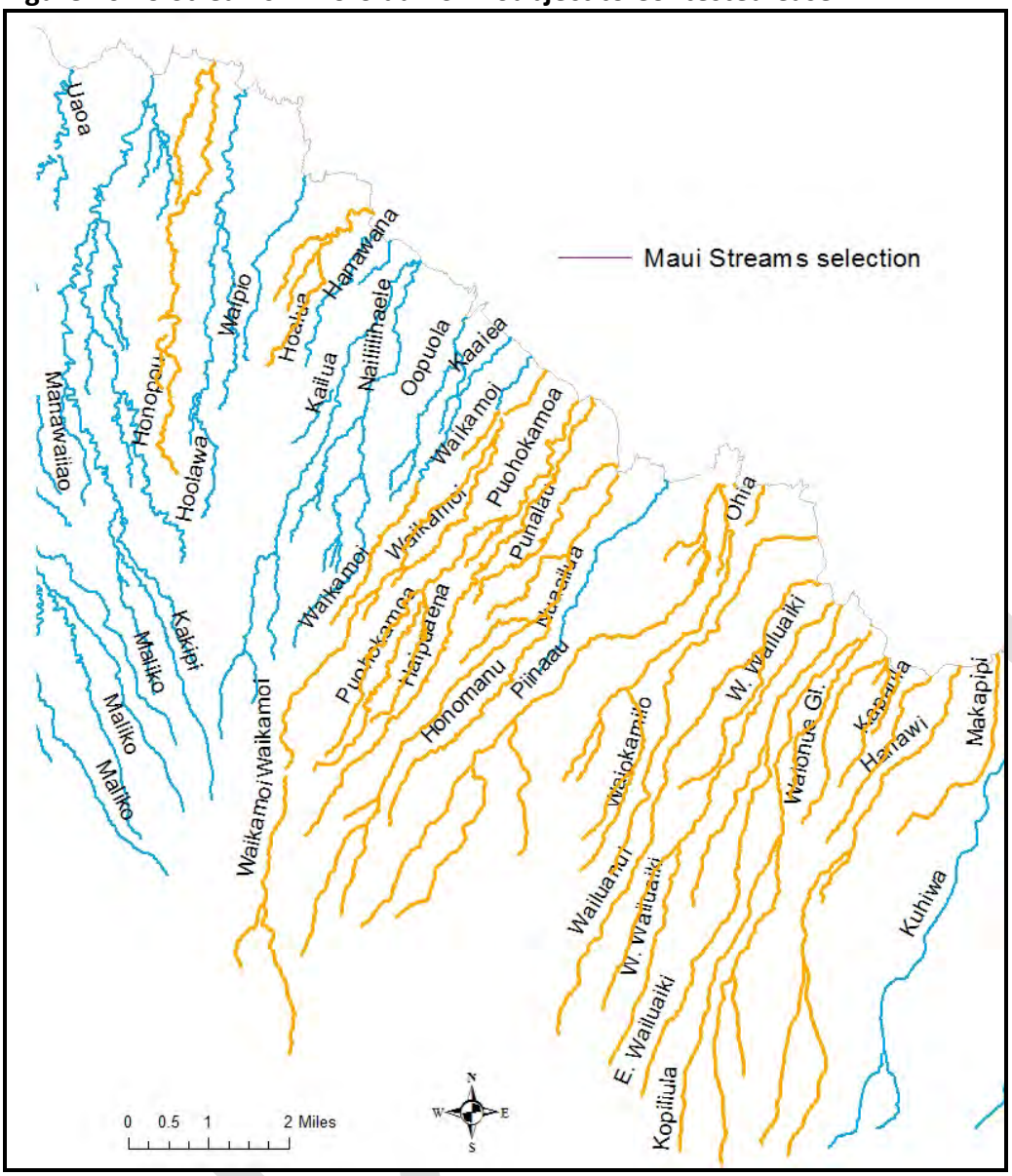
Resources are shared both naturally as hydrogeological units cross Community Plan boundaries, and mechanically where resources are transported between hydrologic and Community Plan regions. The contentious nature of mechanical transport from resource rich watersheds to dry growth areas and agricultural lands are important community concerns and a source of water use conflicts throughout Hawai`i. Surface water has been transported from Ko`olau watersheds to the Central isthmus and to Upcountry for over a century. CWRM has the difficult task of assessing and quantifying the water needs within a region and individual streams against off-stream needs that are diverted and conveyed for a variety of purposes.

East Maui Streams Contested Case

On May 24, 2001, the Native Hawaiian Legal Corporation (NHLC), on behalf of Na Moku ‘Aupuni o Ko'olau Hui (Na Moku), petitioned the CWRM to amend the Interim Instream Flow Standards (Interim IFS) for 27 East Maui streams. The CWRM later concluded that there are 24, not 27 streams that are subject of the contested case. These are illustrated in the figure below. Kualani (or Hamau) and Wahinepe`e Streams are not named in GIS Stream Data/shown on map.

In 2008 and 2010, the CWRM approved amendments to the Interim IFS for about half the streams and established measurable IIFS of status quo conditions for the remaining streams; only six streams had flow restored. The 2010 CWRM vote amended the IIFS through a seasonal approach to address habitat availability for native stream animals for six of the remaining 19 streams. Together with the additions for the first 8 streams, winter total stream restorations for all 27 (24) streams were 13.95 mgd and summer restoration 5.61 mgd. CWRM estimated EMI diversions to range from 134 mgd in winter months to 268 mgd in summer months. Increasing the IIFS for 12 of the 27 (24) streams resulted in 120 mgd to continue to be diverted in winter months and 262 mgd to be diverted in the dry summer months.

Figure 16-29 Streams in Ko`olau ASEA Subject to Contested Case



In June 2010, the MDWS and the NHLC, on behalf of Na Moku, filed petitions for a contested case hearing before the CWRM. In 2014, CWRM voted to conduct the contested case hearing on petitions to amend IIFS for all 27 (24) petitions and streams filed by NHLC. On January 15, 2016 the hearings officer submitted his proposed Findings of Fact (FoF), Conclusions of Law (CoL) and Decision and Order (D&O). Subsequent to HC&S announcing cessation of sugar cane cultivation by the end of 2016, CWRM ordered re-opened hearings to address HC&S current and future use of surface water and the impact on the groundwater; the impact on MDWS's use of surface water due to cessation of sugar operations; the County's position on future use of sugarcane fields, and issues concerning management of the EMI Ditch System. In April 2016, A&B announced that it had decided to fully and permanently restore the East Maui streams

Honopou, Hanehoi (including Puolua), Waiokamilo, Kualani, Pi`ina`au, Palauhulu, and East and West Wailuanui.

In July 2016, CWRM issued an order regarding interim restoration of streamflow, or remain undiverted until further notice: Waiokamilo, Wailuanui (East and West), Makapipi, Hānawi, Waiohue, Waikamoi, Kopiliula, and Puaka`a. In December 2016, the Board of Land and Natural Resources (BLNR) issued a temporary, one-year holdover of A&B/EMI's water licenses subject to the interim restoration order above, and to EMI ceasing all diversions of Honomanū stream for the duration of the holdover period (through December 2017).

Instream Flow Standards

Interim Instream Flow Standards (IIFS) are established to address and protect instream uses. The CWRM June 20, 2018 decision for the East Maui Streams contested case is assumed to satisfy in-stream flow required for healthy taro cultivation demand. The WUDP Ko`olau Sector Report was drafted and submitted for review prior to the June 20, 2018 CWRM decision for East Maui Streams. However, a summary of IIFS by stream according to the 2018 decision is provided in this sector report as Appendix 16A.

In accordance with the Water Code, the CWRM establishes and administers instream flow standards on a stream-by-stream basis as necessary to protect the public interest. Instream flow standard is defined as, "a quantity or flow of water or depth of water which is required to be present at a specific location in a stream system at certain specified times of the year to protect fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses."

The annual mean "Qp" flow is the daily average flow equaled or exceeded "p" percent of the time during the year. Q_{50} is the median or natural base flow for a particular stream segment during a specified period. Base flow is dependent on groundwater discharge while total flow reflects base flow and rainfall runoff. [124] The base flow is a general guideline for the minimal amount of streamflow needed for fish habitat.[125] For perennial streams, the estimated long-term average base flow is 60 to 80 percent and thus 70 percent is used (Q_{70}). Flow exceeded 90 percent of time (Q_{90} flow) is commonly used to characterize low flows.[126] In revising the IIFS, the CWRM defined minimum viable habitat flow (Hmin) for the maintenance of suitable instream habitat to support growth, reproduction, and recruitment of native stream animals in East Maui streams as 64 percent of Median Base Flow (0.64 x BFQ_{50}; also defined as H_{90} by USGS studies). For streams without measurable IFS, the IIFS generally reflects the diverted amounts existing when the status quo interim IFS were adopted, or as subsequently amended by CWRM.

While the Hearing Officer's January 2016 and July 2017 Proposed FoF, CoL and D&Os stated the amount of water to be returned to the streams, the June 2018 decision does not. A&B/HC&S would be able to divert water through the EMI System from some of the streams subject to the

[124] Trends in Streamflow Characteristics at Long-Term Gaging Stations, Hawai`i. USGS SIR 2004-5080.
[125] CWRM Staff Submittal, Steam Diversion Works Permit (SDWP.4175.6) Wailuku River, Maui, August 16, 2016.
[126] Trends in Streamflow Characteristics at Long-Term Gaging Stations, Hawai`i. USGS SIR 2004-5080.

contested case. In comparing established IIFS and base flow at various conditions, 20.35 mgd would be available from the streams subject to the contested case as base flow during median flow conditions (Q50) to potentially divert through the EMI System. About 8 mgd would be available from the streams west of Honopou streams through Maliko Gulch. Therefore about 28 mgd would potentially be available from Wailoa Ditch for use at Kamole Weir for MDWS, to Kula Ag Park and for A&B/HC&S diversified agriculture. However, because freshets (high streamflows during flooding events) and stormwater are allowed to be diverted, much more would potentially be available to divert during "normal", or wet season conditions.

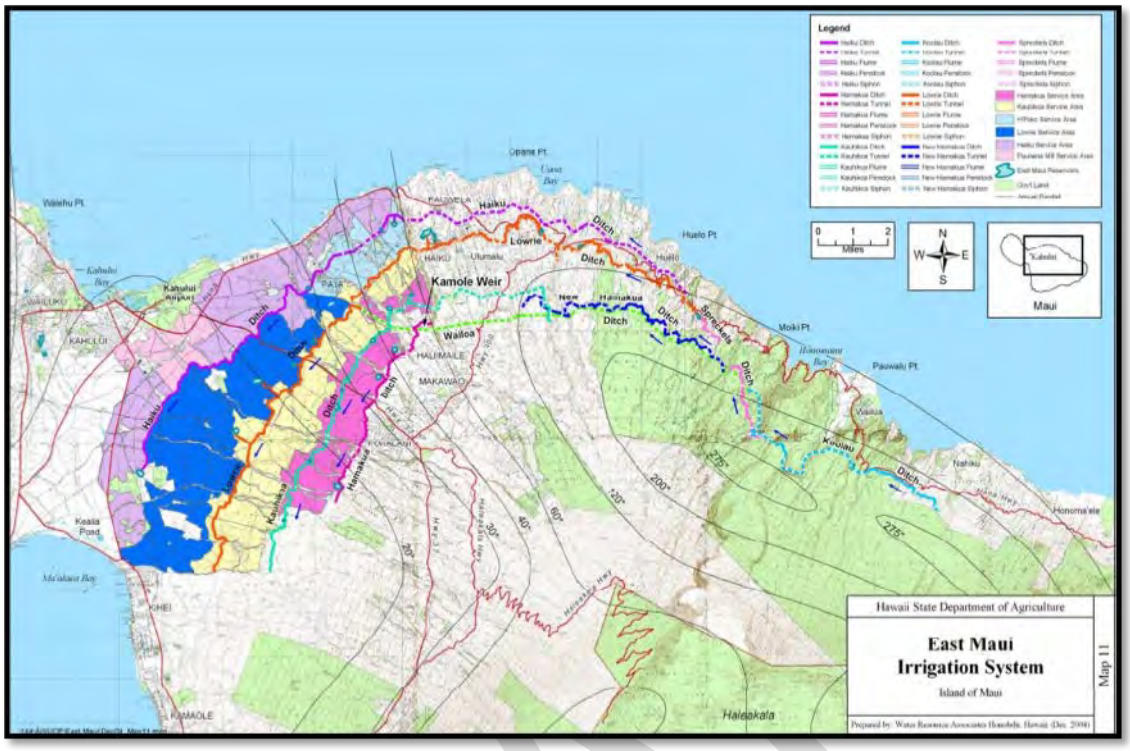
During low flow conditions, or Q90, only 2.21 mgd appears to be available for A&B/HC&S to divert after satisfying IIFS. Because IIFS are monitored on a 12-month moving average basis, any "overdraft" during short periods of droughts may not violate adopted IIFS. It is recognized that requiring a specific amount of streamflow at all times at a specific location is incompatible with the objectives.[127] It appears that the June 2018 Decision does not provide for sufficient diversions during extended droughts to meet proposed demand under the Diversified Agricultural Plan.

Impact on Groundwater Recharge from Surface Water Diversions

The cessation of sugarcane cultivation and heavy irrigation on the Central isthmus have to date unknown impacts on the recharge of Pā`ia and Kahului Aquifer Systems and the associated use and reliability of that brackish groundwater as a water resource. The figure below illustrates the former HC&S plantation irrigation service areas. HC&S reported 28.2 mgd groundwater pumpage from the Kahului Aquifer and 29.1 mgd from the Pā`ia Aquifer in 2014. The water duty for sugarcane is higher than most other crops, but also comparatively salt tolerant. Irrigation demand for the Diversified Agriculture Plan and the associated return recharge from irrigation is assumed to be significantly less. In his Proposal, the hearing officer determined that brackish well water for HC&S is practicably available up to 23.09 mgd, beyond which increasing well water to levels close to that when sugarcane was being irrigated would reduce the yield or the acreage of the plantation that has access to both surface and well water because of higher salt levels in the irrigation water. Alternatively more acreage would have to be left fallow in the rotation of crops so that less well water would be used.[128] The uncertainty of availability of brackish groundwater throughout the HC&S plantation and various crops' long-term tolerance to brackish water should be further addressed in the update of the Agricultural Water Use and Development Plan.

[127] CWRM, June 20, 2018 Findings of Facts, Conclusion of Law and Decision and Order, CCH MA13-01.
[128] CCH-MA-13-01 Hearing Officer's Proposed Findings of Fact and Conclusions of Law, August 2017 pp 153.

Figure 16-30 East Maui Irrigation System Service Areas



Source: Agricultural Water Use and Development Plan, 2004.

Table 16-39 Projected Irrigation Water Use on HC&S Plantation from Ko`olau, Central and Wailuku Aquifer Sectors, Including Water Losses (mgd)

Contested Case Streams	Streams West of Honopou	Central Maui Groundwater (mgd)	Nā Wai ʻEhā Surface Water	Total HC&S Diversified Ag Gross Irrigation Requirement
83.75	8.59	23.09	16.6	**132.03**

Opana and Awalau Surface Water Source and Economic Analysis[129]

HC&S, Maui Land & Pineapple Co., and MDWS utilize a surface water source located in the Ha`ikū Aquifer. Water from the Opana and Awalau intakes goes to the 10 MG Kaili`ili Reservoir. Water is transported to near Olinda Road in Makawao and to another reservoir next to ML&P's Field 274.

[129] Source: Maui County Water Use and Development Plan Upcountry District Final Candidate Strategies Report. July 27, 2009. Carl Freedman. Ha`ikū Design & Analysis.

The water is used to irrigate pineapple fields in Makawao and Kula. Maui Land & Pineapple Company ceased pineapple operations in 2009 and leased a portion of their Upcountry Maui land to the newly formed Hali`imaile Pineapple Company to continue pineapple farming. This system has three intakes from the Opana and Awalau Streams which yield approximately 0.143 mgd.

A diversion in the Opana Stream at an elevation of 2400 feet routes water through a tunnel to the Awalau Stream area. A collector box distributes water from the tunnel and an Awalau spring to pipes serving several users including the MDWS. Currently, the majority of the water from this source feeds a 10 million gallon reservoir serving and managed by a partnership of agricultural users. A minor portion of non-potable water is provided to existing DWS customers.

The Opana/Awalau water source was evaluated as a potential resource option as a source for treatment to supplement MDWS potable uses. Several options were evaluated. The recommendation for this source is to maintain it as a non-potable water source and reserve it for possible future source for treatment for potable use.

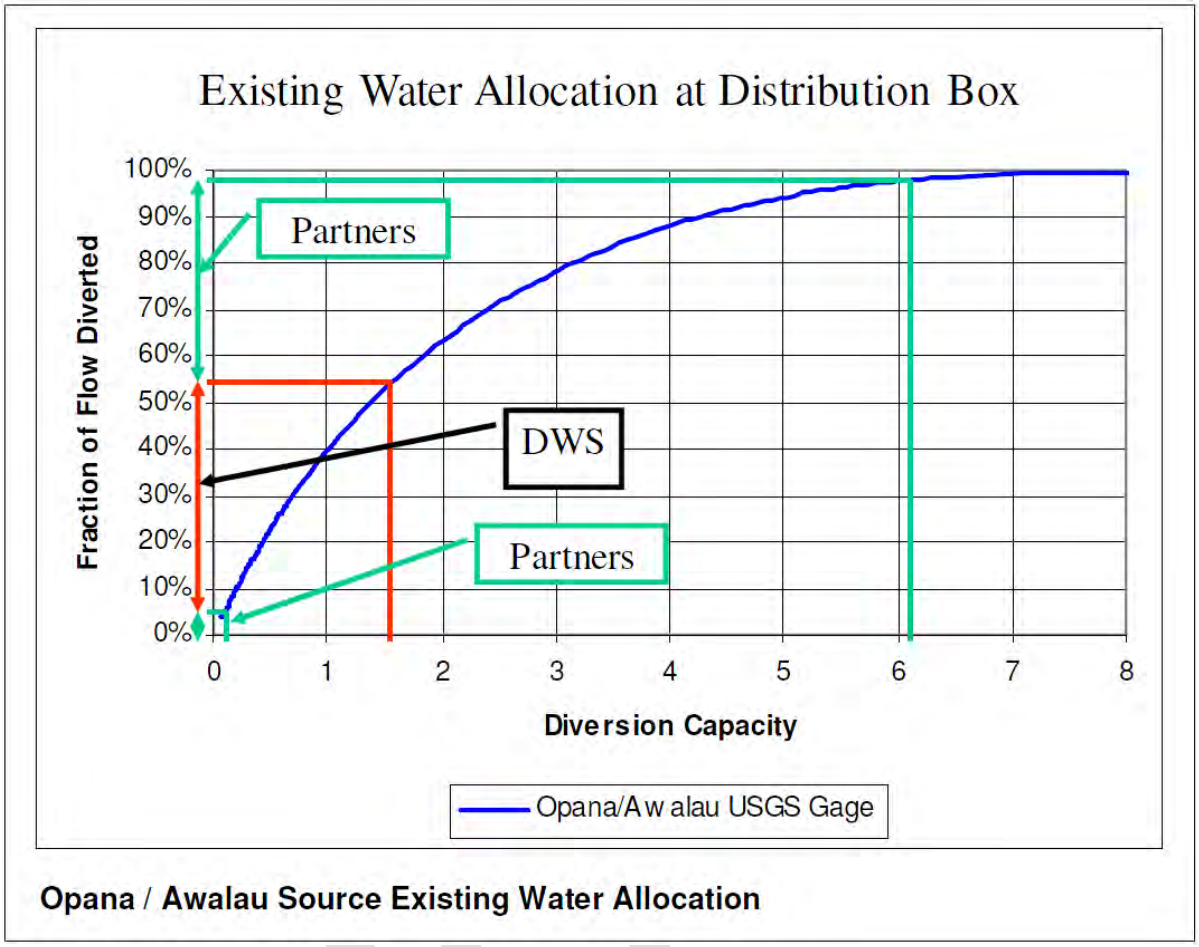
The chart below shows the streamflow characteristics of water emerging from the Opana/Awalau Tunnel and the current allocations of water to the DWS and the agricultural partners. Because there are extended periods, the analysis was based on providing "semi-reliable yield" in which the reservoir would be empty 10 percent of the time. As an integral system only small gains in semi-reliable yield would result from additional reservoir capacity. For example, doubling the current 10 MG reservoir capacity would increase the semi-reliable yield of the Opana/ Awalau System by 22 percent. Based on this analysis it was concluded that it is not practical to provide drought period service reliability to the Upcountry District System by adding reservoir capacity for this resource.

Options for this resource include maintaining the current use as a non-potable agricultural water source or installing a small water treatment unit at the Maluhia Tank site. The economics of installing water treatment depends upon the DWS System status and operation. It would be economical to displace water otherwise produced by basal sources or the Kamole Water Treatment Plant (WTP), but water from the Opana source would rarely be available in the dry conditions that exist when these more expensive resources are required. Usually when water is available from the Opana source water is also available from the Pi`iholo Water Treatment Plant for this area. It is not currently economic to displace water produced at the Pi`iholo WTP with a new treatment unit at the Maluhia Tank site. [130]

Based on this analysis it was concluded that it is not economical to build a water treatment unit for this source to serve potable needs at this time. This source does have value to serve potable uses in the future when more water this area is served by sources from basal wells or water pumped from lower elevations.

[130] Source: Maui County Water Use and Development Plan Upcountry District Final Candidate Strategies Report. July 27, 2009. Carl Freedman. Ha`ikū Design & Analysis.

Figure 16-31 Opana/Awalau Source Existing Water Allocation



Source: Maui County Water Use and Development Plan Upcountry District Final Candidate Strategies Report. July 27, 2009. Carl Freedman. Ha`ikū Design & Analysis.

16.8.4 Climate Adaptation

Issue and Background: Data and research suggest that Hawai'i should be prepared for a future with a warmer climate, diminishing rainfall, declining stream base flows, decreasing groundwater recharge and storage, and increased coastal groundwater salinity, among other impacts associated with drought.

No streamflow projections are available for the coming century but projections include a decline in base flow and low flows, with streamflows becoming more variable and unstable (flashy), especially in wet years.[131] The impact on groundwater recharge will vary locally. A 2017 update to the Hawai`i Drought Plan includes traditional and customary rights and practices as those potentially impacted by droughts. Reduced rainfall and streamflow reduce

[131] Summarized from EcoAdapt. 2016. Climate Changes and Trends for Maui, Lāna'i, and Kaho'olawe. Prepared for the Hawaiian Islands Climate Synthesis Project.

available water for domestic uses and irrigation, and degrading aquatic habitats where stream flora and fauna are gathered. Reduced streamflow may impact other cultural and religious practices, and terrestrial plants causing water stress. The Ko`olau region is assumed to rely more heavily on rainwater catchment due to limited infrastructure and extensive rainfall. Rainfall catchment is the collection of rainwater from a roof or other surface before it reaches the ground. Rainfall is sufficient throughout most of the aquifer sector to support traditional catchment systems. Catchment systems are still vulnerable to drought conditions. Another issue is compromised water quality due to flawed design and wear and tear with no regulatory oversight following construction.

Drought risk and vulnerability are assessed by the CWRM to illustrate the spatial extent and severity of drought risk for different impact sectors throughout the state. The statewide "*Drought Risk and Vulnerability Assessment and GIS Mapping Project"* assesses drought risk areas for three impact sectors: 1. water supply; 2. agriculture; and 3. wildland fire. Areas served by groundwater have a lower risk of drought impacts. Communities that are supplied by surface water have a medium drought risk as most have storage capacity to carry them through short-term declines in rainfall. The most vulnerable to drought are those households relying solely on rainwater catchment. Areas that are not serviced by municipal supply or other known domestic sources and therefore more reliant on catchment systems are more susceptible to drought.

No specific drought mitigation strategies are developed for this region. However, the 2017 update proposes general drought response and mitigation actions that apply state-wide. Recommended mitigation actions that apply for Ko`olau region include those described in Strategy #4 and the following:

- Expand current network of rain gages to improve rainfall monitoring.
- Identify areas at risk to drought and plan for regional response actions and strategies.
- Develop additional storage and/or alternative sources of water supply.
- Develop and implement drought-related public awareness programs.
- Develop incentive programs for drought- resistant practices.

Strategy #4: Convene sector-based drought workshops to assist stakeholders in developing or improving their individual drought/water conservation plans. Focus in the Ko`olau sector should be on catchment systems and contingency supply to supplement or substitute catchment when necessary.

The Ha`ikū Aquifer has been marginally developed and no extensive hydrologic study undertaken. Whether perched water, a higher level groundwater storage above the basal lens, is what feeds the streams must be evaluated by a hydrologic study and monitoring wells. In the 2016 public review of preliminary strategies, the need for hydrologic studies of the Ha`ikū Aquifer was emphasized. Compliance with the terms of the East Maui Water Development Plan Consent Decree is necessary.

Strategy #5 in the Wailuku ASEA Report to continue exploration of East Maui well development for the MDWS Central System can theoretically serve a dual purpose to include source for the MDWS Upcountry System. Interconnection could provide a limited amount of redundancy of production equipment. However, this is of limited value since the Upcountry System is limited by source water capacity in drought rather than redundancy. New resources are necessary to meet demand. The 1995 Pā`ia-Ha`ikū Community Plan's objective "Ensure adequate supply of groundwater to residents of the region before water is transported to other regions of the island" is not assumed to preclude groundwater development that benefit the Upcountry System as a whole.

Strategy #4: Explore East Maui well development in combination with Makawao Aquifer basal groundwater to meet projected demand on the MDWS Upcountry System. Initiate a hydrologic study to determine any negative impact on existing ground and surface water sources, stream flow and influences from dikes. Potential yield is more than the needed 6.3 mgd (potentially in addition to development for the MDWS Central System). Lead agencies would be CWRM and MDWS and hydrologic study to be completed by USGS.

<u>Pā`ia Aquifer</u>

The Pā`ia Aquifer was not considered as a preliminary strategy for potable source in the public process for the WUDP update. Most of the aquifer underlies agricultural land previously in sugarcane or pineapple cultivation. The Maunaolu well, serving a public water system, and the Hāmākuapoko wells, serving the MDWS Upcountry System, require additional Granular Activated Carbon (GAC) treatment to remove chemical contaminants detected in the aquifer. Such additional treatment may be warranted where infrastructure is limited to serve individual projects. The Old Maui High School Campus Revitalization Project is not within the MDWS Central System or Upcountry System service areas. Well development with anticipated GAC treatment is a costly but a potential source option.

The 825 unit planned Hali`imaile Development could also be served by existing wells or new well development in the Pā`ia Aquifer. However, nitrate treatment may be necessary in addition to GAC considering high nitrate levels in nearby wells. It is not recommended that potable source with multiple treatment requirements is pursued if the project can be served by alternative sources outside the Pā`ia Aquifer. It is assumed that the Hali`imaile Development is included in population growth based projections for the region.

The Hāmākuapoko wells can only be used with certain caveats defined in Maui County Code 14.01.050. Water can be used as a backup to the MDWS Upcountry System, when a water shortage is declared, or for agricultural purposes. Although the source capacity of the wells is 1.5 mgd, it is assumed to be used 50% of the time in the future, providing 0.75 mgd supply to the MDWS Upcountry System.

Strategy #5: Explore Pā`ia Aquifer for non-potable demand, and potable use with additional treatment as necessary to serve projects included in the Maui Island Plan that cannot feasibly be serviced by MDWS source and infrastructure. Estimated demand for the Maui High School Campus is about 0.75 mgd. Lead agency is Maui County.

Kama`ole Aquifer Well Development

Kama`ole Aquifer is geographically divided with the communities of Kēōkea and Ulupalakua roughly above 2,000 foot elevation and the Kīhei to Mākena communities roughly below 500 foot elevation. Water is brackish to semi-brackish in the coastal area and can continue to provide non-potable supply to meet irrigation demand in Kīhei, Wailea and Mākena areas.

Water quality and yield are uncertain at higher elevations. As stated in Chapter 15.6.3, DHHL's Kēōkea/Waiohuli project has planned potable water needs of about 0.809 mgd within the State Water Projects Plan time frame. A 1997 agreement for 0.5 mgd potable water from the MDWS Upcountry System is not sufficient to meet projected demand. An exploratory well at the 1,900 foot elevation is developed in the Kama`ole Aquifer that is a feasible option. The WUDP does not adjust DHHL's planned strategy for potable source from the exploratory well and remaining credit from the MDWS Upcountry System. It is assumed that about 0.3 mgd will be needed from Kama`ole Aquifer.

Groundwater Development to Meet Irrigation Needs

Issue and Background: Most of groundwater withdrawn for irrigation purposes are from Kama`ole Aquifer. Future demand for golf course, resort and landscaping irrigation are projected to increase from 3.68 mgd to 5.59 mgd over the planning period. About 0.7 mgd of R-1 water can be used from the Kīhei Wastewater Reclamation Facility. Remaining demand is assumed to come primarily from Kama`ole Aquifer, and from Kahului and Pā`ia Aquifer existing wells.

The only reported irrigation use in Makawao Aquifer is the Pukalani golf course, which also uses reclaimed wastewater. No expanded use is proposed. Non-potable use of the Opana/Awalau tunnel and spring serve primarily agricultural uses Upcountry and possibly a limited number of irrigation needs. Any expanded use of this source is discussed under source development for agricultural demand below.

Table 15-39 Summary of Recommended Strategies Central ASEA

	STRATEGY	PLANNING OBJECTIVES	ESTIMATED COST	IMPLEMENTATION 1: Short-term 1 – 5 years 2: Long-term 5 – 20 years	
				AGENCY	TIME-FRAME
	RESOURCE MANAGEMENT				
1	Explore funding and conduct a cost benefit analysis of improvements to the EMI non-potable conveyance system to mitigate losses and preserve existing reservoirs at risk of decommissioning. Priority components and associated costs TBD.	Maintain sustainable resources Protect water resources Protect and restore streams Maximize efficiency of water use	N/A	Maui County A&B Properties/ EMI	1,2
	CONVENTIONAL WATER SOURCE STRATEGIES				
2	Assess alternative options to restructure and process the existing Upcountry Meter Priority List to improve processing rate and adequate source development.	Provide adequate volume of water supply Maximize reliability of water service	N/A	MDWS	1,2
3	Explore new basal well development in the Makawao Aquifer to accommodate growth Upcountry and add reliable new source. Potential yield is up to 3 mgd.	Provide adequate volume of water supply Maximize reliability of water service Minimize adverse environmental impacts	$4.5 – 6.0 /1000 gallons	MDWS DLNR Public/ private partnerships	1,2
4	Explore East Maui well development in combination with Makawao Aquifer basal groundwater to meet projected demand on the MDWS Upcountry System. Initiate a hydrologic study to determine any negative impact on existing ground and surface water sources, stream flow and influences from dikes. Potential yield is > 6 mgd.	Provide adequate volume of water supply Maximize reliability of water service Minimize adverse environmental impacts	$3.71* /1000 gallons	CWRM USGS MDWS	1,2
5	Explore Pā`ia Aquifer for non-potable demand, and potable use with additional treatment as necessary to serve projects included in the Maui Island Plan that cannot feasibly be serviced by MDWS source and infrastructure. Estimated demand for the Maui High School Campus is about 0.75 mgd.	Provide adequate volume of water supply Maximize reliability of water service	N/A	Maui County	1,2

	STRATEGY	PLANNING OBJECTIVES	ESTIMATED COST	AGENCY	TIME FRAME
6	Execute a long-term source agreement for use and maintenance of the Wailoa Ditch that ensures adequate non-potable supply for the Kula Agricultural Park expansion and potable supply for projected MDWS Upcountry System needs over the planning period.	Provide adequate volume of water supply Maximize reliability of water service	N/A	Maui County MDWS A&B Properties	
7	Pursue hydrologic studies needed to explore the Ha`ikū Aquifer **and** an updated ditch flow analysis to optimize raw water storage and treatment plant capacity at Kamole Weir in order to expedite the most feasible new source. Surface water strategies are contingent on a long-term agreement with A&B Properties allocating adequate surface water for the MDWS Upcountry System.	Minimize cost of water supply Provide adequate volume of water supply Maximize reliability of water service Maintain consistency with General and Community Plans	Surface water $5.15 /1000 gal (20 yr) (construction cost $50M, Operational $1.47/1000 gal) Groundwater $3.71/1000 gal	MDWS	1,2
ALTERNATIVE WATER SOURCE STRATEGIES					
8	Consider alternative sources of irrigation water including wastewater reuse, recycled stormwater runoff, and brackish well water in land use permitting to mitigate low flow stream conditions. Require alternative sources for irrigation when reasonably available in county discretionary land use permitting.	Maintain sustainable resources Protect and restore streams Minimize adverse environmental impacts Maximize efficiency of water use Maintain consistency with General and Community Plans	N/A	Maui County DEM HC&S	1,2
9	Expand distribution from the Kahului WWTF and the application for planned energy crops. Potential available recycled water is 4.2 mgd.	Maximize efficiency of water use Maintain consistency with General and Community Plans	$6.7M	MDEM HC&S	1,2
10	MDWS and MDEM collaborate to identify private-public partnerships, state and federal funding sources to maximize utilization of recycled water produced at the Kīhei WWTF and supplemental non-potable sources for seasonal use of R-1 water.	Maximize efficiency of water use Maintain consistency with General and Community Plans	(Transmission South Kīhei to Wailea $21M)	MDEM MDWS	1,2

*20 year total cost includes upfront capital costs, operation and maintenance, repair and replacement and does not include inflation and other economic factors

Table 16-41 Summary of Recommended Strategies Ko`olau ASEA

	STRATEGY	PLANNING OBJECTIVES	ESTIMATED COST	IMPLEMENTATION 1: Short-term 1 – 5 years 2: Long-term 5 – 20 years	
				AGENCY	TIME-FRAME
	RESOURCE MANAGEMENT				
1.	Seek dedicated, long-term and broad based core funding for maintaining and expanding watershed protection areas and providing for watershed maintenance in East Maui and Hāna watersheds for habitat protection and water security.	Maintain sustainable resources. Protect water resources. Protect and restore streams.	$0.8M – $1M per year	MDWS Maui County CWRM DLNR	1
2.	Support and promote community grassroots initiatives to collaborate with state and land owner partnerships to increase participation in natural resource management and to ensure adequate access and opportunities for traditional uses of the region's natural resources. Use established moku process to consult on resource management.	Maintain sustainable resources. Protect water resources. Protect and restore streams.	N/A	Public-private partnerships Aha Moku DLNR Maui County	1
3.	Support collaborative hydrogeological studies to inform impact from climate change and future well development on groundwater health for Ha`ikū and Honopou Aquifers.	Maintain sustainable resources. Protect water resources. Protect and restore streams.		CWRM USGS MDWS	2
4.	Convene sector-based drought workshops to assist stakeholders in developing or improving their individual drought/water conservation plans. Focus in the Ko`olau Sector should be on catchment systems and contingency supply to supplement or substitute catchment when necessary.	Provide adequate volume of water supply. Maximize reliability of water service.	$50K/year	CWRM NRWA	2

The recommended strategies for the Hāna Aquifer Sector address the goals and objectives identified in the Hāna Community Plan and the WUDP public process for the region that evolve around resource protection and management; traditional uses of the region's natural resources and self-sufficiency.

The table below summarizes recommended strategies and indicates the planning objectives that each strategy supports. Estimated costs are, unless indicated otherwise, life cycle costs for the twenty-year planning period per 1,000 gallons. Life cycle costs include capital, operational and maintenance costs and include inflationary effects. The cost to develop and implement sustainability projects can be difficult to quantify per volume water supply. Lead agency, or organization to implement a strategy is proposed as a starting point. The time frame for implementation is indicated as short-term – less than 5 years, and long-term – 5–20 years. Many strategies are multi-year actions with implementation beginning within 5 years and continuing through the long-term (indicated as 1, 2).

Table 17-38 Summary of Recommended Strategies Hāna ASEA

	STRATEGY	PLANNING OBJECTIVES	ESTIMATED COST	IMPLEMENTATION 1: Short-term 1 – 5 years 2: Long-term 5 – 20 years	
				AGENCY	TIME-FRAME
	RESOURCE MANAGEMENT				
1.	Seek dedicated, long-term and broad based core funding for maintaining and expanding watershed protection areas and providing for watershed maintenance in East Maui and Hāna watersheds for habitat protection and water security.	Maintain sustainable resources Protect water resources Protect and restore streams	$0.8M – $1M per year	MDWS Maui County CWRM DLNR	1
2.	Support and promote community grassroots initiatives to collaborate with state and land owner partnerships to increase participation in natural resource management and to ensure adequate access and opportunities for traditional uses of the region's natural resources. Use established moku process to consult on resource management	Maintain sustainable resources Protect water resources Protect and restore streams	N/A	Public-private partnerships Aha Moku DLNR Maui County	1
	CONVENTIONAL WATER SOURCE STRATEGIES				
3.	Complete optimization studies/source development analysis for the MDWS Hāna subsystem (PWS 217) in order to assess basal well development needs by 2025. Costs of regional well development is not assessed. Compare to 20 year life cycle costs estimated for Haiku/Central well development	Provide adequate volume of water supply Maximize reliability of water service Minimize adverse environmental impacts Provide for DHHL needs	$3.55 per 1,000 gallons	MDWS DHHL	2

4.	The Commission on Water Resource Management to establish Instream Flow Standards on a stream-by-stream basis to protect the public interests of the Hāna aquifer sector. Recognizing that other regions with competing off-stream needs must be prioritized, this strategy is proposed as a medium to long-term implementation time frame.	Protect and restore streams Protect cultural resources Maintain sustainable resources Protect water resources	N/A	CWRM USGS	2
5.	Convene sector-based drought workshops to assist stakeholders in developing or improving their individual drought/water conservation plans. Focus in the Hāna sector should be on catchment systems and contingency supply to supplement or substitute catchment when necessary.		$50,000	MDWS CWRM DOH	2

17.9.1 Implementation Program

In consistency with the Maui Island Plan, strategies recommended and adopted in the WUDP do not legally bind the agencies and organizations to execute. The recommendations provide guidance for land use and infrastructure, including the county CIP program, over the planning period.

Timing and prioritizing of resource strategies, particularly groundwater development are tied to actual population growth in this region. One key to sustain the traditional lifestyle and sense of place is prioritizing resource management and seeking guidance from the larger resourceful and knowledgeable community.

Over the planning period, implementation and performance of the recommended strategies can be assessed using qualitative criteria and quantitative targets formulated in the WUDP Part I, Table 3-3.

Table 18-25 Summary of Recommended Strategies Kahikinui ASEA

	STRATEGY	PLANNING OBJECTIVES	ESTIMATED COST	IMPLEMENTATION 1: Short-term 1 – 5 years 2: Long-term 5 – 20 years	
				AGENCY	TIME-FRAME
	RESOURCE MANAGEMENT				
1.	Support and provide broad based funding to sustain and expand watershed protection and restoration on a landscape level on leeward Haleakalā for long term habitat augmentation and water security	Maintain sustainable resources Protect water resources Protect and restore streams	$950,000 per year	MDWS Maui County	1
2.	Support and promote regional grassroots, homestead community and moku initiatives to collaborate with state and land owner partnerships to ensure participation and adequate access and opportunities for traditional uses of the region's natural resources.	Maintain sustainable resources Protect water resources Protect and restore streams	N/A	Public-private partnerships Aha Moku DLNR Maui County	1
	CONVENTIONAL WATER SOURCE STRATEGIES				
3.	DHHL proposed strategies in the 2017 State Water Projects Plan: fog drip catchment system. Recommendation is to combine with groundwater development to supply build-out of Kahikinui homesteads.	Provide for DHHL needs Provide adequate volume of water supply Maximize reliability of water service Minimize adverse environmental impacts	$1.8M capital cost	DHHL	1, 2
4.	MDWS Upper Kula system accommodate existing priority list applications. Potential additional demand (4,000 gpd) depend on MDWS groundwater source development for Upcountry System. Regional domestic groundwater development and catchment systems, including fog drip supplement supply	Provide adequate volume of water supply Maximize reliability of water service	N/A	MDWS	1,2

5.	MDWS and KR collaboratively explore two alternatives: a) improving the existing non-potable system; and b) dual water system with a potable well providing for potable needs as a separate system, and a non-potable system remain to be served by surface water for agricultural use. Explore technical and financial assistance and grant opportunities		Non-potable system $750K, $35,8K per meter Potable system $2.6M, $123.9K per meter	MDWS Kaupō Ranch DOH SDWB RCAC HRWA	
6.	Convene sector-based drought workshops to assist stakeholders in developing or improving their individual drought/water conservation plans. Focus on ranching and may include retaining experts in respective sectors.		$50,000	CWRM DLNR DOFAW, NRCS, DOA, DHHL, MDWS, USDA Farm Services Agency Kaupō Ranch, Ulupalakua Ranch, Haleakalā Ranch	

18.9.1 Implementation Program

In consistency with the Maui Island Plan, strategies recommended and adopted in the WUDP does not legally bind the agencies and organizations to execute. The recommendations provide guidance for land use and infrastructure, including the county CIP program, over the planning period.

Timing and prioritizing of resource strategies, particularly groundwater development are tied to actual population growth in this sparsely populated region. Rehabilitation of this once extensive and diverse forested area would greatly improve the land and freshwater resources to sustain population growth and self-sufficient communities in Kahikinui. Prioritizing resource management and augmentation strategies are key to future build-out and supported by the DLNR watershed initiative program “The Rain Follows the Forest.” This initiative seeks to double the acreage of protected watershed forests by 2021.

Over the planning period, implementation and performance of the recommended strategies can be assessed using qualitative criteria and quantitative targets formulated in the WUDP Part I, Table 3-3.